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Markkula (M.) & Myllymäki (S.). **The composition of the *Apion* (Col., Curculionidae) population of grassland legumes and some wild leguminous plants.**—*Ann. ent. fenn.* **24** no. 3 pp. 97–124, 13 figs., 22 refs. Helsinki, 1958.

In continued work on pests of leguminous forage crops in Finland [*cf. R.A.E.*, A **46** 1, 361; **47** 304], investigations were made to the north-west of Helsinki to find which species of *Apion* occur on the various cultivated and wild plants concerned, in order to determine their importance as pests. Samples were collected at approximately weekly intervals throughout the growing season between 1953 and 1957 by sweeping with a net in fields of red, alsike and white clovers (*Trifolium pratense*, *T. hybridum* and *T. repens*), lucerne and a mixture of red clover with timothy [*Phleum pratense*] and meadow fescue [*Festuca pratensis*], grown for seed or fodder, and from wild red, alsike and white clover, zigzag and black clover (*T. medium* and *T. spadiceum*), tufted vetch (*Vicia cracca*) and meadow pea (*Lathyrus pratensis*). Inflorescences were collected from the plants in 1956 and 1957, and the insects emerging from these or taken in the nets included 16,500 belonging to 19 species of *Apion*.

Ten species of *Apion* occurred in pure stands of red clover, and averages of 37·2, 31·7 and 13·6 per cent. of the specimens belonged to the three injurious species, *A. virens* Hbst., *A. apricans* Hbst. and *A. assimile* Kby., and 12·7 per cent. to *A. dichroum* Bedel (*flavipes* (Payk.)). The abundance of the various species varied considerably in the different years. The pest species were most abundant in 1955–56, and, of them, *A. virens* was the most numerous in the first three years and *A. apricans* in the last two. These species had two peaks of abundance during the growing period, due to the overwintered adults and to those of the new generation, respectively. A total of 17 species was obtained from the mixed stands, 61·9, 18·7, 7·4 and 2·8 per cent. of the specimens belonging to *A. virens*, *A. flavipes*, *A. apricans* and *A. assimile*, respectively; the addition of timothy to red clover increased the density of *A. virens*, but decreased the numbers of *A. apricans* and *A. assimile*. The last two were more abundant in the second- and third-year leys than in the first-year ones and were more abundant on wild than on cultivated red clover; some moved from wild to cultivated plants after hibernation.

Eleven species were swept from alsike clover, and *A. flavipes* and *A. seniculum* Kby., which both had two peaks of abundance during the growing period, comprised 86·5–99·5 and 0·4–10·3 per cent. of the population. Six species were obtained from white clover, *A. flavipes* and *A. virens* comprising 84·6 and 9·6 per cent. of the totals; only adults of *A. flavipes* emerged from the inflorescences of either of these clovers. *A. assimile* and *A. apricans* (94:6) emerged from inflorescences of zigzag clover, and black clover was an important food-plant of *A. flavipes*. Small numbers of adults of eight species were swept from lucerne, which was not a food-plant of any species of *Apion* in the area investigated. No pest species seemed to reproduce in tufted vetch or in meadow pea, although several others were found on them.

Bognár (S.) & Csehi (É.). **A takácsatka probléma és jelentösége magyarország almatermesztésében.** [On the problem of the spider mite and its importance for apple production in Hungary.]—*Rec. Hung. agric. Exp. Stas* (C) **52** pt. 2 pp. 75–101, 10 figs., 52 refs. Budapest, 1959. (With summaries in Russian & English.)

The following is based on the authors' summary. Spider mites have increased in numbers and injuriousness on fruit trees, especially apple, in

Hungary following the increased use of DDT against insect pests and the favourable trend of ecological conditions. The authors review the situation from the literature and their own investigations, which were begun in 1956, and list the species concerned, of which those so far identified are *Bryobia praetiosa* Koch, *Tetranychus telarius* (L.), *Panonychus ulmi* (Koch) (*T. pilosus* C. & F.), and *Eotetranychus carpini* (Oudm.). The first three are the most important. Their food-plants are noted, and it is stated that the most favourable conditions for development are 29–30°C. [84·2–86°F.] and 35–55 per cent. relative humidity. *T. telarius* develops the most rapidly, 6–7 days sufficing at 34°C. [93·2°F.] and 45 per cent. relative humidity. They are preyed on by insects, notably *Stethorus* (*Scymnus*) *punctillum* Weise, *Anthocoris nemorum* (L.), *Orius* (*Triphleps*) *niger* (Wolff), *O.* (*T.*) *minutus* (L.) and *Chrysopa perla* (L.), and good control is given by some spray materials, including lime-sulphur, methyl-demeton (Metasystox) and chlorfenson, which last is toxic to the summer eggs as well as the mobile forms.

Todd (E. L.). **The fruit-piercing moths of the genus *Gonodonta* Hübner (Lepidoptera, Noctuidae).**—*Tech. Bull. U.S. Dep. Agric.* no. 1201, [4+] 52 pp., 12 pls., 17 refs. Washington, D.C., 1959.

In this revision of the neotropical genus *Gonodonta*, the author gives a key to the 37 species recognised, several of which are new or have new subspecies, followed by notes concerned mainly with their synonymy, distinguishing characters, food-plants (where known) and distribution. Little is known of their immature stages, but the larvae appear to be of no economic importance. The adults of some of them cause serious injury by piercing the fruits of *Citrus*, and those that have caused the greatest losses in this way are *G. bidens tenebrosa*, subsp.n., in Mexico in 1953, and *G. nutrix* (Cram.), in Cuba in 1941 and subsequently in Florida [*cf. R.A.E.*, A **47** 378] and Mexico.

Gurney (A. B.) & Brooks (A. R.). **Grasshoppers of the *mexicanus* group, genus *Melanoplus* (Orthoptera: Acrididae).**—*Proc. U.S. nat. Mus.* **110** no. 3416 pp. 1–93, 5 pls., 18 figs., 10 pp. refs. Washington, D.C., 1959.

In this revision of the North American grasshoppers of the group of *Melanoplus mexicanus* (Sauss.), six species, with five subspecies other than the typical ones, are recognised. A key to them is given, based on the males, followed by information, arranged under the form concerned, on their synonymy, morphology (including genitalia), distribution, bionomics and economic importance, and all are illustrated. *M. bilituratus* (Wlk.), which has for some time been misidentified as *M. mexicanus* [*cf. R.A.E.*, A **47** 128], is the species of most economic importance. Three subspecies of it are recognised. The typical one, which occurs in the United States and Canada, is sometimes migratory; its synonyms include *M. atlanis* (Ril.) and *M. affinis* Scud. The other subspecies of it are *M. b. vulturnus*, n., and *M. b. defectus* Scud., which are recorded from the United States. The true *M. mexicanus* is widely distributed in Mexico and also occurs in Texas, though its limits there are not known. The other species are *M. devastator* Scud., in the western United States, *M. bruneri* Scud., in the north-western United States and Canada, *M. spretus* (Walsh) [*cf.* **37** 35], in the central United States and Canada, and *M. borealis* (Fieb.), which has three subspecies in addition to the typical one, in the northern United States and Canada.

Steinhaus (E. A.). *Serratia marcescens* **Bizio as an insect pathogen.**—*Hilgardia* **28** no. 14 pp. 351–380, 7 figs. (1 col.), 3 pp. refs. Berkeley, Cal., 1959.

The following is based on the author's summary. The red-pigmented bacterium, *Serratia marcescens*, has caused outbreaks of disease among laboratory- or insectary-reared insects [*cf. R.A.E.*, A **27** 597; **35** 129] and has been used to produce experimental infections, but little is known of the occurrence of outbreaks of it in nature. The studies here described were carried out with a view to ascertaining how far the occurrence of infection is related to factors of stress that may be present under laboratory conditions but absent from the field. Tests were made on insects of nine species, and it was found that *S. marcescens* was highly pathogenic to many of them when inoculated into the body cavity, but much less so when ingested, though there were variations for different strains of the bacterium. Virulence was not consistently enhanced by repeated insect passages, and the use of abrasives increased the likelihood of infection in some insects (larvae of *Bombyx mori* (L.) treated by microinjection *per os* or administered treated food and those of *Galleria mellonella* (L.) treated in the first way), but not in others. Very high or low temperatures and relative humidities had little effect. In *Colias eurytheme* Boisd. and some other insects, infected larvae infected healthy ones among which they were placed, and, in *G. mellonella*, *S. marcescens* inhibited the development of *Bacillus thuringiensis* when fed to an infected larva, but was enabled to develop more freely, or to act more easily as a secondary invader, by the presence of *B. thuringiensis* (or its crystalline toxin).

Transactions of the First International Conference of Insect Pathology and Biological Control.—9½ × 6¾ in., 655 pp., illus., refs. Bratislava, Slov. Akad. Vied, 1959. Price unbound *Kčs* 56; bound *Kčs* 63.

This conference took place in Prague in August 1958 and was attended by members of 17 countries. The 70 scientific papers read at it were grouped to form nine symposia, dealing, respectively, with insect bacteriology (13 papers), insect mycology (four papers), insect virology (11 papers), protozoology and helminthology (nine papers), taxonomy of entomophagous insects (five papers), evaluation of results of introductions (four papers), increasing the effect of parasitic insects (nine papers), monophagous and polyphagous insects (seven papers), and international cooperation (eight papers). The text of these and reports of the discussions that followed in each symposium (in the original languages used), the opening and closing addresses (also in the original languages) and the resolutions of the conference (in English, Russian and German) are presented in this volume. Abstracts of selected papers are given below.

Talalaev (E. V.). **A bacteriological method of controlling** *Dendrolimus sibiricus* [*in Russian*] (pp. 51–57, 2 figs., 18 refs.) (with a summary in German). Tests on the control of *Dendrolimus superans* (Btlr.) (*sibiricus* Chtv.) in forests in western Siberia by means of *Bacillus dendrolimus*, which was isolated from this insect in Irkutsk in 1949, were carried out in 1956. Dusts prepared from the spores were used. Infection was caused in two ways, from the dust itself, which resulted in dense localised foci of infected larvae, and from infective material originating from these that was washed over larger areas by rain or snow. When the larvae were infected just before pupation, the dead pupae in the webs formed an effective reservoir for infection by the second method.

Kudler (J.), Lysenko (O.) & Hochmut (R.). **Versuche mit der Anwendung von einigen bakteriellen Suspensionen gegen den Wickler *Cacoecia crataegana* Hb.** [Experiments on the use of bacterial suspensions against *Archips crataegana*] (pp. 73–79, 4 figs. (1 fldg.)) (with a summary in Russian). Some 97 per cent. mortality of the older larvae and pupae of *Archips* (*Cacoecia*) *crataegana* (Hb.) was caused by *Pseudomonas chlororaphis* during an outbreak of this insect in forests in Czechoslovakia, and attempts were therefore made to use it during a further outbreak that occurred in 1958. Following laboratory tests, suspensions of various bacteria, alone or mixed, were applied as aerosols to sample areas against larvae in the fourth and fifth instars. Mortality ranged up to 80–90 per cent. in the centres of the treated areas, but was much lower towards the edges. *P. chlororaphis* was the most active agent and became distributed over considerable distances, whereas the others were much more restricted in their effect.

Chugunin (Ya.V.). **Cycles of increase of pest insects and the microbiological method of controlling them** [*in Russian*] (pp. 81–93, 11 refs.) (with a summary in English). Outbreaks of the gipsy moth [*Lymantria dispar* (L.)] occur at intervals in the Crimea, last about three years and are terminated by unspecified parasites and diseases, the cycle gradually moving from south to north. The diseases are caused by Protozoa, fungi and bacteria, and dusts and sprays prepared from dead larvae gave high mortality when applied experimentally to a heavily infested area.

Kovačević (Ž.). **Einfluss subletaler Konzentrationen der Insektizide auf das Erscheinen von Krankheiten bei einigen Insekten** [The influence of sublethal doses of insecticide on the occurrence of diseases in insects] (pp. 115–119) (with a summary in Russian). Field and laboratory tests in Yugoslavia showed that treatment with sublethal doses of DDT caused outbreaks of latent virus, bacterial or protozoan diseases in larvae of *Lymantria dispar* (L.), *Euproctis chrysorrhoea* (L.) and *Hyphantria cunea* (Dru.), probably as a result of the physiological weakening caused.

Wille (H.). **Infektionsversuche mit *Rickettsia melolonthae* Krieg und Beiträge zur Histopathologie der "Lorscher Krankheit" der Engerlinge von *Melolontha melolontha* L.** [Infectivity tests with *Rickettsiella melolonthae* and contributions to the histopathology of the Lorsch disease of the larvae of *M. melolontha*] (pp. 127–141, 8 figs., 10 refs.) (with a summary in Russian). The results are given of 25 experiments in which larvae of *Melolontha melolontha* (L.) were infected with *Rickettsiella* (*Rickettsia*) *melolonthae*, the causal agent of Lorsch disease [*cf. R.A.E.*, A **44** 207], by intralymphal and peroral application or by treatment of the soil in which they were kept. Depending on the method of infection, mortality reached 90–100 per cent. in 50–180 days. The rickettsiae attack the cells of the fat-body intracellularly, multiply, and then reach the haemolymph. In the final stages of the disease, almost all the fat cells are attacked and contain crystalline inclusion bodies, the nuclei are disrupted, and death ensues, although it may occur at an earlier stage if secondary infections are also present.

Telenga (N. A.). **Die Anwendung der Müskardinenpilze im Verein mit Insektiziden für die Bekämpfung der Schädlingsinsekten** [The use of muscardine fungi in combination with insecticides for the control of insect pests] (pp. 155–168, 2 col. pls., 3 graphs, 4 refs.) (with a summary in Russian). Details are given of field experiments in the Ukraine in which two muscardine fungi (*Beauveria bassiana* and *Metarrhizium anisopliae*) were used with DDT or BHC for the control of various pests. The fungi were cultured on maize seeds, which were then ground to form a powder that was applied as such or as a suspension in water. The results showed a synergistic effect when the fungi were used with low doses of insecticide.

Against *Cleonus* (*Bothynoderes*) *punctiventris* (Germ.) on beet, the fungus powders at 4·5 lb. per acre were applied in various ways (to the seed or soil) and the soil was treated with 6·3 lb. 25 per cent. BHC per acre at sowing. As a result, the number of weevils per sq.m. was reduced from 2·7–3·3 to 0·6 in 1956 and from 4–4·75 to 2 or less in 1957, *B. bassiana* giving a better kill than *M. anisopliae* and the combination with either being more effective than BHC alone.

Against *Cydia pomonella* (L.) on apple in 1957, the bark was sprayed with the preparation of *B. bassiana* and DDT at times when the larvae were seeking sites in which to spin their cocoons. Mortality was 61·2 per cent. for the first generation and 71·2 per cent. for the second (overwintering) generation, as compared with negligible mortality for either agent alone.

Kerner (G.). **Eine Mykose bei** *Dasychira pudibunda* **L. und ihre Verwendung zur biologischen Bekämpfung von anderen Forstinsekten** [A mycosis of *D. pudibunda* and its use for the biological control of other forest insects] (pp. 169–176, 5 figs., 4 refs.) (with a summary in Russian). *Isaria farinosa* was isolated from overwintering pupae of *Dasychira pudibunda* (L.) in the soil during the last stages of an outbreak of this Lymantriid on beech in eastern Germany in 1954–56. It was cultured in the laboratory, and a dust prepared from the spores proved effective against larvae of *Lymantria* (*Ocneria*) *dispar* (L.), *L. monacha* (L.), *Bupalus piniarius* (L.) and *Sphinx* (*Hyloicus*) *pinastri* L. A suspension was less satisfactory.

Evlakhova (A. A.). **Regular features of fungus epizootics in insects and details of their appearance in** *Eurygaster integriceps* [*in Russian*] (pp. 177–180) (with a summary in English). Hibernating adults of *Eurygaster integriceps* Put. in the Soviet Union are attacked by *Beauveria bassiana* and *Spicaria farinosa* [*cf.* **48** 348]. *B. bassiana* tolerates a wide range of temperature (3–30°C. [37·4–86°F.]) and also attacks other insects occurring with *E. integriceps*.

Bergold (G. H.). **Some topics of insect virology** (pp. 191–195, 2 figs., 3 refs.) (with a summary in Russian). In the course of this paper, the author suggests that the term ' latent ' should be avoided in favour of ' occult ' in relation to insect viruses, unless an infection is present, and states that the majority opinion at a recent meeting of experts was in favour of adding the suffix ' *virus* ' to the end of the generic names of the viruses that are pathogenic to insects and are named according to the binomial system, with citation of authors, *e.g.*, *Bergoldiavirus calypta* (Steinhaus) for the virus causing granulosis in *Choristoneura* (*Cacoecia*) *murinana* (Hb.) [*cf.* **43** 172].

Thompson (C. G.). **A polyhedrosis virus for control of the Great Basin tent caterpillar,** *Malacosoma fragile* (pp. 201–204, 5 refs.) (with a summary in Russian). In tests in which the polyhedrosis virus that infects *Malacosoma fragile* (Stretch) [*cf.* **46** 125] was used against this insect on aspen (*Populus tremuloides*) in mountain areas in New Mexico and Colorado, low-volume sprays affording 30,000 million spores per acre gave 40–50 per cent. mortality of the larvae when maize syrup was added to them and were better than weaker sprays.

Rivers (C. F.). **Virus resistance in larvae of** *Pieris brassicae* **(L.)** (pp. 205–210, 3 graphs, 1 ref.) (with a summary in Russian). In 1955, an outbreak of granulosis virus occurred in larvae of *Pieris brassicae* (L.) in a laboratory culture in England [*cf.* **46** 198]. At its height, only about 1 per cent. of the larvae survived, but the culture was re-established from these. Experiments with this stock showed that it was more resistant to infection with the virus than were other larvae, but that the resistance could be overcome, especially during the first two instars, by using very large doses of virus.

Schmidt (L.). **Die Granulose von** *Hyphantria cunea* **Drury, eine neu**

entdeckte Viruskrankheit [The granulosis of *H. cunea*, a newly discovered virus disease] (pp. 227–230) (with a summary in Russian). Details are given of a granulosis virus found attacking the larvae of *Hyphantria cunea* (Dru.) in the laboratory in Yugoslavia in 1957 and for which the name *Bergoldia kovachevici* has been proposed.

Veber (J.). **Vergleichende Histopathologie der Mikrosporidie** *Nosema bombycis* **in verschiedenen Wirtstieren** [Comparative histopathology of *N. bombycis* in different hosts] (pp. 301–313, 7 figs., 13 refs.) (with a summary in Russian). In laboratory experiments in 1956–57, *Lymantria dispar* (L.), *Orgyia antiqua* (L.), *Euproctis chrysorrhoea* (L.), and *Diacrisia* (*Spilarctia*) *lubricipeda* (L.) proved to be immune to infection with *Nosema bombycis*, but larvae of *Malacosoma neustria* (L.), *Stilpnotia salicis* (L.), *Thaumetopoea processionea* (L.), *Pieris brassicae* (L.) and *Hyphantria cunea* (Dru.) were readily infected, in addition to silkworms (*Bombyx mori* (L.)). Histopathological investigations are described.

Kramer (J. P.). **Some observations on a microsporidiosis in the European corn borer,** *Pyrausta nubilalis* **(Hbn.)** (pp. 323–325, 3 refs.) (with a summary in Russian). Investigations in Illinois showed that *Perezia pyraustae* is transmitted by infected females of *Ostrinia* (*Pyrausta*) *nubilalis* (Hb.) to their progeny by internal and external contamination of the eggs [*cf.* **46** 440], though their egg-production is curtailed [*cf.* **43** 243]. The pathogen is now widely distributed in *O. nubilalis* throughout the maize belt of the State, but its incidence fluctuates with the season. Hitherto undescribed forms of it are noted.

Weiser (J.). **Ein neuer Nematode als Parasit der Engerlinge des Maikäfers,** *Melolontha melolontha* **in der Tschechoslowakei** [A new nematode as a parasite of the larvae of *M. melolontha* in Czechoslovakia] (pp. 331–336, 2 figs., 7 refs.) (with a summary in Russian). A nematode found parasitising a few larvae of *Melolontha melolontha* (L.) in Czechoslovakia is described as *Neoaplectana melolonthae*, sp.n.

Telenga (N. A.). **Taxonomical and ecological characteristics of species from the genus** *Trichogramma* **(Hymenoptera, Chalcidoidea)** (pp. 355–360, 8 refs.) (with a summary in Russian). On the basis of morphological characters and biological properties, the author recognises three species of *Trichogramma* in the Soviet Union [*cf.* **45** 474]. These are *T. evanescens* Westw., which has geographical forms that do not cross, *T. embryophagum* (Htg.), of which *T. fasciatum* (Perkins) and *T. pretiosum* Ril. are treated as synonyms and which appears to lack males, and *T. cacoeciae* Marchal, which has three biological races, the typical one, *pallidum* Meĭer and *pini* Meĭer. Their hosts and distribution are noted.

Sedlag (U.). **Untersuchungen über Bionomie und Massenwechsel von** *Diaeretus rapae* **(Curt.) (Hymenoptera: Aphidiidae)** [Investigations on the bionomics and population change of *D. rapae*] (pp. 367–373, 5 graphs, 2 refs.) (with a summary in Russian). *Diaeretus rapae* (Curt.) constituted 99·9 per cent. of the primary parasites reared from *Brevicoryne brassicae* (L.) and about 11·5 per cent. of those from *Myzus* (*Myzodes*) *persicae* (Sulz.) on cruciferous crops in eastern Germany in 1954–57. Observations on its bionomics and seasonal occurrence are recorded.

Huba (A.). **Effektivität einer Introduktion von Parasiten der San José Schildlaus in der Tschechoslowakei** [Effectiveness of an introduction of parasites of the San José scale in Czechoslovakia] (pp. 395–403, 5 figs., 4 refs.) (with a summary in Russian). *Quadraspidiotus perniciosus* (Comst.) is an important pest of fruit trees in Czechoslovakia and is little attacked by local parasites and predators. *Prospaltella perniciosi* Tower was therefore imported from the Soviet Union in 1957 and became established in two localities in which it was released, though it spread little. Parasites later

obtained from China were found to be morphologically indistinguishable from *P. perniciosi* from Russia, but differed in bionomics and ecology.

Fankhänel (H.). *Meteorus versicolor* **Wesm. als Parasit von** *Euproctis chrysorrhoea* **L. und** *Thaumetopoea processionea* **L. und seine Einsatzmöglichkeiten** [*M. versicolor* as a parasite of *E. chrysorrhoea* and *T. processionea* and possibilities of using it] (pp. 415–420, 1 fig.) (with a summary in Russian). Forests of oak in eastern Germany were severely damaged by *Euproctis chrysorrhoea* (L.) and *Thaumetopoea processionea* (L.) in 1950–55 [*cf.* **48** 269]. *Meteorus versicolor* (Wesm.) was the most important parasite of both, and observations on it are recorded.

Yakhontov (V. V.). **Theoretical bases for a new development in the biological method of controlling insect pests** [*in Russian*] (pp. 455–479, 18 refs.) (with a summary in German). Examples are given of the increase in vitality obtained by crossing strains of predacious insects from different localities in the Soviet Union. The principal species used were *Coccinella septempunctata* L. and *Stethorus punctillum* Weise.

Hodek (I.), Holman (J.), Starý (P.) & Štys (P.). **Natural enemies of the bean aphid** (*Aphis fabae* **Scop.) in Czechoslovakia** (pp. 553–557) (with a summary in Russian). In Czechoslovakia, *Aphis fabae* Scop. is an important pest of sugar-beet. It is parasitised on its primary food-plant (*Euonymus europaeus*) by *Trioxys angelicae* (Hal.), *Praon abjectus* (Hal.) and *Ephedrus plagiator* (Nees) and on its secondary ones by *Aphidius fabarum* Marshall, and predacious insects attack it on both. Notes on all these are given.

Kennedy (J. S.) & Booth (C. O.). **Responses of** *Aphis fabae* **Scop. to water shortage in host plants in the field.**—*Ent. exp. appl.* **2** no. 1 pp. 1–11, 4 graphs, 6 refs. Amsterdam, 1959. (With a summary in German.)

The following is based on the authors' summary of this account of further investigations in England on the effect of water strain in plants on *Aphis fabae* Scop. [*cf. R.A.E.*, A **48** 8]. The behaviour of free and caged alate virginoparae was observed on the leaves of *Euonymus europaeus* and beet growing together in dry summer weather, before and after watering of part of the bed. Colonisation, reproduction and the survival rate on mature leaves were lower on plants of both species that were not watered, the effects being more pronounced on *Euonymus* than on beet, and even if water was available to the roots the aphids were unfavourably affected on *Euonymus* when atmospheric conditions favoured rapid transpiration. When the plants recovered from water strain in the evening or during the day after watering, the suitability of mature leaves improved temporarily, in comparison with other leaves or with the mature leaves of plants that had not suffered water strain. The differing results previously obtained in field cages [**39** 198] can consequently be attributed to weather changes. The better resistance of the woody primary food-plant, *Euonymus*, to drought is in agreement with its resistance to infestation by *A. fabae* in summer and favours migration of the aphids from it.

van der Laan (P. A.). **Correlation between rainfall in the dry season and the occurrence of the white rice borer** (*Scirpophaga innotata* **Wlk.) in Java.**—*Ent. exp. appl.* **2** no. 1 pp. 12–20, 1 graph, 7 refs. Amsterdam, 1959. (With a summary in German.)

The following is based on the author's summary. *Scirpophaga innotata* (Wlk.) occurs only in regions with pronounced wet and dry seasons. At the end of the rainy season, the full-fed larvae in the stems of the maturing

rice enter diapause and survive the subsequent dry season in the stubble, pupating and giving rise to adults with the onset of the next heavy rains [*cf. R.A.E.*, A **25** 453]. The Pyralid is one of the principal pests of rice in certain regions of Java, although its occurrence is very irregular. The view has long been held that rainfall during the dry season reduces the population and consequently the damage by the next generation, and comparison of records of precipitation and borer damage over the period 1915–40 for five regions of East Java confirmed this, though in only nine of the 14 years in which the dry season was dry or very dry was damage even fairly heavy in the following wet season. It is concluded that rainfall in the dry season is the main factor responsible for outbreaks, though others are also concerned, and a method of predicting damage, based on it, has been developed.

Evans (W. G.) & Gyrisco (G. G.). **A study of the flight habits of the European chafer.**—*Ent. exp. appl.* **2** no. 1 pp. 21–26, 1 graph, 9 refs. Amsterdam, 1959. (With a summary in German.)

The following is virtually the authors' summary. By using a large cage in the field in New York and a system of marking, the flight activities of 36 females and 49 males of *Amphimallon majalis* (Razoum.) [*cf. R.A.E.* A **31** 301] were followed during June and July 1954. It was found that the beetles made 1–11 flights, with males averaging five flights and females 4·5. More males made 8–11 flights than did females, and males made more flights on consecutive evenings. The average life span of the males was found to be six days, while the females lived on the average for 6·5 days. The main flight period lasts about one month, though some beetles can be observed flying in the evenings for about two months after the main flight has ended. The populations observed in the field are composed of successive groups of beetles, which emerge, fly for several days and then die. These groups overlap each other, so that high numbers of beetles are present in the trees each evening during the main flight period. Variations in the physical characteristics of the soil habitat could be responsible for the differences in the time of maturity of the larvae and the subsequent "first-time" emergence of the adults.

Neitzel (K.) & Müller (H. J.). **Erhoehter Virusbefall in den Randreihen von Kartoffelbestaenden als Folge des Flugverhaltens der Vektoren.** [Increased virus infection at the edges of potato plots as a result of the flight behaviour of the vectors.]—*Ent. exp. appl.* **2** no. 1 pp. 27–37, 3 figs., 15 refs. Amsterdam, 1959. (With a summary in English.)

The following is based on the authors' summary. In the course of investigations on the significance of the infestation flight of aphids on the distribution of virus diseases, differences in infection at the edges and in the centre of potato fields were analysed for an area in central Germany, in which virus infection is high and seed potatoes consequently cannot be grown year after year, and one in the north, where seed potatoes are successfully grown. In 1956, a plot in each district was kept free from aphids by spraying, and the tubers were tested for infection in 1957. The rate of infection was found to be 12 times as high in the first as in the second district, and this must have been due to the activities of alate aphids, especially *Myzus persicae* (Sulz.), the infestation flight of which was 29 times as great in the first as in the second area. In both districts, infection decreased sharply from the edge to the centre of the field [*cf. R.A.E.*, A **48** 85]. In the central district, the third row showed barely half the amount

of infection that occurred at the edge, and the fifth row only one third. In the north, infection in the second row was only a tenth of that at the edge. The vectors fly extremely near the ground and stop at the edge of the crop because of plant density, few penetrating to the interior of the field. This was evident from an earlier observation that late-planted crops show less difference in infection from edge to centre than early ones, since the plants are small at the time of the flight and thus equally exposed to infestation by alates.

Breukel (L. M.) & Post (A.). **The influence of the manurial treatment of orchards on the population density of *Metatetranychus ulmi* (Koch) (Acari, Tetranychidae).**—*Ent. exp. appl.* **2** no. 1 pp. 38–47, 1 pl., 5 graphs, 15 refs. Amsterdam, 1959. (With a summary in German.)

The following is virtually the authors' summary. The influence of the nitrogen content of apple leaves on the development of *Panonychus* (*Metatetranychus*) *ulmi* (Koch) was studied under laboratory and semi-field conditions in Holland. The experiments in the laboratory showed that a higher egg production per female in 24 hours, a lower mortality rate of the eggs, larvae and nymphs, and a shorter period of development of the male as well as the female mites was obtained on leaves with a high nitrogen content [*cf. R.A.E.*, A **46** 102]. However, these differences were statistically significant only in the case of egg production and mortality rate. From the experiments under semi-field conditions, it became evident that the egg-female ratio on leaves with high nitrogen content originating from manured rootstocks was also significantly higher than on leaves with a low nitrogen content. In both series of experiments, the differences gave a factor of 1·6. The experiments confirm the results obtained from extended field trials, in which an effect of the manuring of apple trees on the development of *P. ulmi* was found. It is concluded that the mortality of predators of *P. ulmi*, caused by chemical treatment, is not the only reason why the mite populations are stimulated in well kept orchards. The higher nitrogen content of the leaves, brought about by cultural practices, in particular manuring, may be of considerable importance.

Archer (T. E.) & Zweig (G.). **Direct colorimetric analysis of cholinesterase-inhibiting insecticides with indophenyl acetate.**—*J. agric. Fd Chem.* **7** no. 3 pp. 178–181, 6 graphs, 14 refs. Easton, Pa., 1959.

A method is described for the estimation of residues of cholinesterase-inhibiting insecticides in plant material by colorimetric measurement of the hydrolysis product obtained when cholinesterase is allowed to act on indophenyl acetate in the presence of the purified extracts. It was successfully used for Sevin, phorate (Thimet), Guthion and Trithion (O,O-diethyl S-p-chlorophenylthiomethyl phosphorodithioate), and standard curves for these are given. Various cholinesterases were suitable, but they were inhibited to different degrees by Sevin, so that the choice is of some significance.

Coulson (D. M.), Cavanagh (L. A.) & Stuart (J.). **Gas chromatography of pesticides.**—*J. agric. Fd Chem.* **7** no. 4 pp. 250–251, 2 graphs, 3 refs. Easton, Pa., 1959.

Data are given showing that gas chromatography is a promising technique for the rapid analysis of insecticide residues on plants. It gave good results

with aldrin, dieldrin, DDT, γ BHC (lindane), parathion, malathion and demeton (Systox) and with mixtures of them between 220 and 280°C. Details of the technique are described.

Coe (D. G.), Hurtig (H.), Perry (B. J.) & Sherlock (E. S.). **Some new organophosphorus compounds with insecticidal properties.**—*J. agric. Fd Chem.* 7 no. 4 pp. 251–255, 23 refs. Easton, Pa., 1959.

In the investigations described, the compounds were tested for general insecticidal toxicity by confining *Sitophilus granarius* (L.) in wheat treated with acetone solutions of the compounds, for fumigant toxicity by enclosing leaves bearing *Myzus persicae* (Sulz.) over deposits of the compounds on filter paper from which the aphids were separated by a cheesecloth barrier, for systemic toxicity by keeping plants bearing *M. persicae* with their roots in solutions of the compounds, for cholinesterase inhibition by a technique using fly-brain cholinesterase, and for mammalian toxicity by injection into mice. Bis-N-dimethyl and bis-N-diethyl methylphosphonic diamide proved of little interest because of low insect toxicity combined with marked phytotoxicity, but several methyl phosphonamidates showed pronounced systemic activity. The best of these were isopropyl methylphosphonomorpholidate and n-amyl N-dimethyl methylphosphonamidate, and the second also showed high general and fumigant action. These two were the strongest cholinesterase inhibitors, and the first of them had some mammalian toxicity. Other similar compounds were toxic when directly ingested by *S. granarius*. Di-n-butyl, di-n-amyl and diethyl methylphosphonates showed general and short-lived systemic toxicity, with low anticholinesterase activity.

McBride jr. (J. J.). **Persistence of residues of 2,4,5,4′-tetrachlorodiphenylsulfone in Florida *Citrus* fruits.**—*J. agric. Fd Chem.* 7 no. 4 pp. 255–256, 3 refs. Easton, Pa., 1959.

The following is substantially the author's summary. Residues of Tedion, which effectively controls *Panonychus* (*Metatetranychus*) *citri* (McG.) on *Citrus*, were determined on all the major *Citrus* fruits grown in Florida at varying times after spraying. The results, which are given, showed that the material is absorbed into the peel and persists in it for more than three months [*cf. R.A.E.*, A **48** 186], but that none or very little reaches the pulp or juice.

San Antonio (J. P.). **Demonstration of lindane and a lindane metabolite in plants by paper chromatography.**—*J. agric. Fd Chem.* 7 no. 5 pp. 322–325, 21 refs. Easton, Pa., 1959.

The following is based partly on the author's summary. When carrots, which are known to accumulate γ BHC (lindane) [*cf.* next abstract but one], and other plants were grown in soil to which the insecticide had been added and extracts of them were subsequently analysed by a paper-chromatographic method, an oil-soluble chlorine-containing metabolite was detected, in addition to unchanged γ BHC, in the fibrous roots, edible root and leaf tissue of the carrots. It was present in variable amounts, mostly in the fibrous roots, but could not be identified with certainty.

Gunther (F. A.), Blinn (R. C.), Benjamini (E.), Kinkade (W. R.) & Anderson (L. D.). **Magnitudes and natures of nicotine residues on and in field-treated Texas mustard greens.**—*J. agric. Fd Chem.* 7 no. 5 pp. 330–335, 4 graphs, 24 refs. Easton, Pa., 1959.

The following is substantially the authors' summary. When several nicotine sprays and a dust were applied to plants of Texas mustard greens in the field in California, analysis of the residues on the aerial parts showed that, contrary to the usually held view that nicotine volatilises rapidly, the persistence half-lives averaged 4·5 days for initial deposits of 10–50 parts per million. Aged residues were found by chromatographic and spectrophotometric procedures to contain nicotine, cotinine, nornicotine and anabasine.

Lichtenstein (E. P.). **Absorption of some chlorinated hydrocarbon insecticides from soils into various crops.**—*J. agric. Fd Chem.* 7 no. 6 pp. 430–433, 17 refs. Easton, Pa., 1959.

The following is virtually the author's summary. A study was made of the extent to which insecticides may be absorbed and translocated from contaminated soils into plant tissues and the relationships between absorbance of insecticidal residues, soil types, and crops. Lindane [γ BHC], DDT, and aldrin were absorbed into crops, the degree being dependent on the crop, the soil type in which the crop had grown, the insecticide, and its concentration within the soil. Carrots not only absorbed more insecticide than any other crop, but in the case of γ BHC accumulated greater quantities of the chemical than occurred in the soil. The insecticides were most readily absorbed from a sandy loam and least from a muck soil. The amounts absorbed by the same crop from the same type of soil were not in direct proportion to the concentration of the insecticide recovered from the soil, and relatively less insecticide was absorbed from soils in which the insecticide was most concentrated. Crops grown in aldrin-treated soils contained within their tissues both aldrin and dieldrin [*cf. R.A.E.*, A **47** 57].

Hueck (H. J.) & Luijten (J. G. A.). **Organo-tin compounds as textile preservatives.**—*J. Soc. Dy. Col.* **74** pp. 476–480, 4 refs. Bradford, 1958. Also as *Meded. cent. Lab. T.N.O.* no. 49. Delft.

Since certain organic tin compounds are toxic to insects and fungi, they were tested as preservatives of wool against insect attack and of cellulose-containing textiles against attack by micro-organisms. In the preliminary tests against insects, woollen serge was soaked in solutions of the compounds in benzene or trichloroethylene, and samples containing up to 1 per cent. preservative were exposed to larvae of *Tinea bisselliella* (Humm.) and *Anthrenus flavipes* Lec. (*vorax* Waterh.). Visual assessment of damage showed good protection by triethyltin ethoxide, hydroxide and p-toluenesulphonamide, but not from mono-, di- or tetra-alkyltin compounds, and further tests were therefore made, mainly with trialkyl compounds, in which the wool samples were baited with yeast suspension and insect damage to them was estimated from weight loss. Reductions of not more than 12 and 15 per cent. are considered satisfactory against the two insects, respectively, and 0·25 per cent. triethyltin hydroxide and 0·05 per cent. tributyltin oxide gave satisfactory results against both and 0·3 per cent. diethyllauryltin acetate against *A. flavipes*. None gave satisfactory protection

after the samples had been washed three times, and it is concluded that, though about as toxic as DDT before washing, these compounds, like it, are ineffective where permanent moth-proofing is required.

Hueck (H. J.). **A new development in the mothproofing of wool.**—*Tex* **17** no. 9 pp. 1216–1233, 2 graphs, 12 refs. Enschede, 1958. Also as *Meded. cent. Lab. T.N.O.* no. 52. Delft.

In tests of dieldrin as a permanent moth-proofing agent [*cf. R.A.E.*, A **48** 126], comparison of the loss in weight of samples of woollen fabric, dipped in solutions of dieldrin in xylene or of DDT or γ BHC (lindane) in petroleum ether and then exposed to larvae of the clothes moth [*Tineola bisselliella* (Humm.)] for 14 days at 25°C. [77°F.] and 65 per cent. relative humidity, showed that concentrations of 0·01–0·1 per cent. dieldrin, 0·05–0·1 per cent. DDT or 0·05 per cent. γ BHC in the cloth gave adequate protection, but that though dieldrin showed the best resistance to washing or dry-cleaning, it approached the effective limit (about 12 per cent. loss of weight) only at 0·05 per cent. after being washed once.

When dilute aqueous emulsions were used, most woollen material impregnated with 0·05–0·1 per cent. actual dieldrin was adequately protected against *T. bisselliella*, even after being washed five times, and carpet yarn even after being washed or dry-cleaned five times; treatment with cold emulsion appeared to compare favourably with impregnation in the dye bath. A content of 0·2 per cent. dieldrin from emulsion protected fabric from *Anthrenus flavipes* Lec. (*vorax* Waterh.) after five launderings, and 0·05 or 0·1 per cent. dieldrin almost eliminated feeding by the larvae on carpet yarn. Dyeing, potting and exposure to light or perspiration did not appear to affect the degree of protection. Some aspects of the toxicology of dieldrin are discussed, and it is concluded that impregnation of clothing with dieldrin presents little or no hazard to the wearer.

Wilson (F.). **A review of the biological control of insects and weeds in Australia and Australian New Guinea.**—*Tech. Commun. Commonw. Inst. biol. Contr.* no. 1, 10 × 7¼ in., v [+ 2] + 102 pp., 11½ pp. refs. Farnham Royal, Bucks., Commonw. agric. Bur., 1960. Price £1 5*s*.

This comprehensive review of work on biological control carried out in Australia and Australian New Guinea (comprising the eastern half of New Guinea, the Bismarck Archipelago and Bougainville Island in the Solomon Islands) is in three main parts. In the first and largest is given, for each of 55 species or groups of invertebrate pests, including about 50 insects of agricultural importance, information on all introductions of natural control agents and liberations of native beneficial species that have been made against them, with, in some cases, lists of native natural enemies. The individual pests are considered under the headings of orchard and fruit pests, garden and field pests, silvicultural pests, and miscellaneous pests, of which one attacks stored products and the others are of medical or veterinary importance [*cf. R.A.E.*, B **48** 162]. This part also contains an introductory section dealing with general papers relating to the biological control of insects, and a summary of the results obtained in both areas. In addition to lists of pest species of which the status has been reduced to varying degrees or not at all following introductions, with the control agents concerned, and one of pests against which natural enemies have been introduced but are not known to be established, this includes a discussion of the criteria by which the success of biological control operations

should be judged. The second part contains similar information for 13 noxious weeds (including seven species of *Opuntia*) in Australia, as well as accounts of preliminary work on the natural enemies of five other weeds against which no liberations were made. The final part contains discussions of the relative success against exotic and native pests; the sources of the beneficial species that have been established; the use of diseases, of native natural enemies and of introduced natural enemies other than insects and disease organisms; the regular or periodic liberation of natural enemies from laboratory stocks; the factors that have prejudiced the success of attempts at biological control; and the adverse affects of insecticides on biological control in Australia.

Kelsey (J. M.). **Damage by clover case-bearer caterpillars.**—*N.Z. J. agric. Res.* **1** no. 4 pp. 525–526. Wellington, N.Z., 1958.

In recent years, the seeds of white clover (*Trifolium repens*) in Ashburton County, in the South Island of New Zealand, have been severely damaged by the larvae of *Coleophora* spp. [*cf. R.A.E.*, A **48** 247], and the effect of damage on seed yield was accordingly investigated in 1955. Samples of ten mature flower-heads were collected during the second and third weeks of February from each of 50 evenly spaced sampling points in each of nine fields, including two of red clover (*T. pratense*), and only seeds containing living larvae were recorded as damaged by *Coleophora*. The average numbers of florets per flower-head, florets that set seed and seeds per floret in seven white-clover fields were 54, 48 and 3·6, respectively. The average number of good seeds per flower-head in the only field that was uninfested was 172·8, and in the remaining six the number was 169 in a two-year-old stand and 26·2–29·7 in four three-year-old stands and 3·4 in a fifth. Damage to red clover by *Coleophora* had not hitherto been recorded in New Zealand, but, although the average numbers of florets per head, florets that set seed and seeds per floret were 96·5, 60·4 and 1 in the two fields investigated, the average number of good seeds produced was only 50·62.

Palmer-Jones (T.) & Forster (I. W.). **Effect on honey bees of DDT applied from the air as a spray to lucerne; notes on lucerne pollination.** —*N.Z. J. agric. Res.* **1** no. 5 pp. 627–632, 2 figs., 7 refs. Wellington, N.Z., 1958.

The following is almost entirely the authors' summary. Ten acres of a lucerne crop in the South Island of New Zealand were sprayed from the air with a DDT emulsion spray at 2 lb. p,p′DDT in 10 gal. water per acre. Prior to spraying, 23 hives of bees had been established in the crop. The spray was applied early in the morning, when there was practically no bee activity, but shortly afterwards conditions were suitable for maximum bee activity. No adverse effect on adult honey bees or brood was observed, but the crop was strongly repellent to the bees for a day after spraying [*cf. R.A.E.*, A **43** 412]. In connection with pollination, counts of honey bees and bumble bees were made on the crop. All bumble bees were referable to *Bombus terrestris* (L.), which is a more efficient pollinator of lucerne than the honey bee, but even if allowance is made for this extra efficiency, the density of bees covering the crop fell well below that recommended in the United States. Various weeds in the vicinity of the lucerne competed for the attention of the bees; if these weeds had been destroyed, more bees would have visited the crop.

Palmer-Jones (T.), Forster (I. W.) & Line (L. J. S.). **Effect on honey bees of toxaphene and Strobane applied to white clover pasture.**—*N.Z. J. agric. Res.* **1** no. 5 pp. 694–706, 6 figs., 5 refs. Wellington, N.Z., 1958.

Losses of seed-crops of white clover (*Trifolium repens*) in New Zealand following attack by *Coleophora spissicornis* (Haw.) and the species tentatively identified as *C. alcyonipennella* (Koll.) [*cf. R.A.E.*, A **48** 247] amount to about 10 and in some cases may be as high as 80 per cent. [*cf.* preceding abstract but one]. Insecticidal sprays applied in spring and summer, when bees are also present on the crop, appear to offer most promise for control. Since preliminary laboratory tests indicated that toxaphene and Strobane were the materials least likely to harm bees, their toxicity to bees in the field was tested, and the following is based on the authors' summary of the work.

Toxaphene was sprayed and dusted over 12 acres of white-clover pasture at the rate of 5 lb. actual toxaphene per acre, and Strobane was sprayed over eight acres of white-clover pasture at 5 lb. actual Strobane per acre. All applications were made in the early morning, when no bees were flying. Bees from neighbouring experimental apiaries collected nectar extensively from the clover flowers in both experimental areas soon after all these applications; pollen was also collected. There was no evidence of bee mortality or adverse effect upon brood after the toxaphene applications. A slight mortality in field bees was apparent after the Strobane application, but no dead bees were brought out of the hives and brood was unaffected.

It is considered that toxaphene causes no bee mortality when applied to clover pasture. Strobane causes only negligible losses of bees and is safe to use. These conclusions apply only when toxaphene and Strobane are applied at a time when bees are not flying. It is unlikely that toxaphene would cause bee mortality if put into general use on crops; Strobane can safely be used on clover pasture, but should be applied with caution elsewhere.

Kelsey (J. M.). **Control of *Pieris rapae* by granulosis viruses.**—*N.Z. J. agric. Res.* **1** no. 5 pp. 778–782, 1 fig., 2 refs. Wellington, N.Z., 1958.

Two strains of granulosis virus were used in the experiments described. One was from *Pieris rapae* (L.) in New Zealand [*cf. R.A.E.*, A **46** 360] and was tentatively determined by E. A. Steinhaus as *Bergoldia virulenta* of Tanada [*cf.* **45** 263]. The other originated from *Pieris brassicae* (L.) in England and was stated by K. M. Smith to kill the latter within about four days and also to kill larvae of *P. rapae*, though he suspected that it merely activated a granulosis virus latent in them [*cf.* **46** 198]. The first virus was newly prepared, and the second had been stored for nearly 16 months at room temperature.

The experiments were begun in New Zealand in March 1957, and the following is partly based on the author's summary of this account of the work. In the laboratory, complete kill of larvae of *P. rapae* that had fed for 24 hours on rape leaves dipped in aqueous preparations of the viruses was obtained in 9 and 11 days, respectively, with no real differences in symptoms. In a field test, a plot of rape, 28 × 6 yards in extent, in which about 1 per cent. of the larvae were already affected, was sprayed with the New Zealand virus, of which a concentrate prepared by macerating 50 infected larvae in 10 cc. water was used at 20 cc. in 2 gal. water with a wetting agent on 10th March. By 21st March, all the larvae seen (3,881) had been killed by the disease, whereas on the adjoining control plot,

which had been sprayed with water and the wetting agent, the number killed was 2,047, the remaining 311 all appearing healthy. It was observed that where the virus was present when the larvae were hatching, they died in the late second instar and caused little damage, but that where infection was delayed until the third instar, they fed for up to ten days before succumbing and the damage was extensive.

In an investigation of natural infection carried out in the Canterbury district between early February and early April 1957, the results of sampling in 61 different areas showed that larval mortality due to the New Zealand virus was not common up to the end of January, but that it rose to nearly 20 per cent. by the end of the first week in February, about 57 per cent. by 21st February, 75 per cent. in the last week of February and 77 per cent. in March, and then fell to 70 per cent. during April. During the latter two months and late February, however, there were nine cases of complete kill and a further ten cases in which mortality was very high.

Kelsey (J. M.). **Damage in ryegrasses by *Hyperodes griseus* Hust.**—*N.Z. J. agric. Res.* **1** no. 5 pp. 790–795, 1 fig., 7 refs. Wellington, N.Z., 1958.

A survey was made in Canterbury, New Zealand, during 1955–57 to assess the damage caused by *Hyperodes griseus* Hust. to rye-grass [*Lolium*], of which it is a serious pest, together with observations on the bionomics of this weevil [*cf. R.A.E.*, A **27** 547]. The stands examined were of perennial rye-grass [*L. perenne*], a cultivated short-rotation variety, or Italian rye-grass [*L. multiflorum*] and all were infested; damage was most apparent in the south, but some first- and second-year stands were completely destroyed in all districts. Losses were mainly caused by thinning of the stand, usually in patches. Feeding by the adults on either the upper or the lower surface causes the leaves to become silvery in appearance, mainly at the tips but also in spots or stripes, and heavy infestations may defoliate the plants, which, however, usually recover unless also damaged by the larvae. The most serious damage results from larval tunnelling in the tillers, and plants in young stands were killed by an infestation of one larva per tiller; the plants first wilt and turn brown, and the damage then resembles that caused by grass grubs [*Costelytra zealandica* (White)], from which it can be distinguished by the uninjured root system. The larvae also sometimes killed the plants by moving down into the crown after harvest. A third type of damage occurred in plants in which the seed-head was developing; larvae in the stems usually moved upwards, and no seed was set. Maximum damage of this sort occurred in short-rotation rye-grass, but amounted to only 6·9 per cent. of the total number of straws; nevertheless, the weevil was often numerous enough for severe injury to occur if high larval populations coincided with the production of flowering stems.

Adults were present throughout the year, being active in warm weather in winter, and there were two generations. First-generation eggs were present from 31st August until 8th November, larvae from the last week in September until mid-December, and pupae from the last week in November until mid-January; adult emergence continued from the beginning of December until the end of February. Second-generation eggs were present from 17th December until the end of March, larvae from mid-January until the beginning of May and pupae from the beginning of March until mid-May. In the laboratory, the eggs hatched in 12–24 days, but in the field, larvae were not seen until 23 days after oviposition; the pupal stage varied from 7 to 15 days. When soil samples from heavily infested fields were slowly flooded from below, populations of over 28 adults per sq. ft. were indicated, though the number observed in the field rarely

exceeded two per sq. ft., and it is assumed that an average of 1–2 adults per sq. ft. observed by day is indicative of a heavy infestation. The eggs were laid, usually two together, but occasionally singly or in threes, in a pocket made in the back of the leaf sheath where it adheres closely to the tiller, usually close to the ground. The newly hatched larvae tunnelled downwards in the leaf sheath, and then entered the tiller, at or between nodes, or ringed the outside of the nodes. In young plants, they invariably moved downwards into the crown, but, in plants producing seed heads, they remained in the internode near the point of entry, and, in plants with seed-heads, they entered near a node and moved first upwards and then downwards. When fully fed, they dropped to the ground and pupated in the upper soil. In addition to rye-grass, they fed on other pasture grasses, cereals and the petioles of young rape, in which, however, they did not tunnel extensively. The adults fed on numerous grasses, cereals, leguminous forage plants and cruciferous crops.

Estimates of the damage, made in five pastures in 1955 and 1956 and six in 1957 and based on the number of tillers per sq. yd. that were beyond recovery, averaged 65 per cent. for Italian, 60 per cent. for the short-rotation and 37·5 per cent. for perennial rye-grass; these are considered to be typical of the heaviest infestations. In experimental plots examined in March 1957, short-rotation, but not perennial, rye-grass was almost completely eliminated. Damage to seed-heads was most severe where the stands were thinnest, owing to the presence of weevils carried over from initial infestations during the early stages of grass establishment. Seed cleanings from 363½ bushels of dressed seed (representing 330·4 lb. per acre) from one area amounted to 140 lb., of which 109 lb. comprised adults of *H. griseus*; this represented an average of 21·1 adults per sq. ft., and the reduction in the seed crop was estimated at 265·9 lb. per acre.

DDT and γ BHC (lindane) were effective against the adults in laboratory tests, but an application against each generation would probably be necessary in the field. A rotation in which potatoes followed cereals, and cruciferous crops preceded rye-grass, might prove of value.

Viado (G. B.) & Banaag (A. F.). **Control of lanzones bark borers with organic insecticides.**—*Philipp. Agric.* **42** no. 5 pp. 163–172, 2 pls. College, Laguna, 1958.

Two Lepidopterous bark borers, *Prasinoxena* sp. and *Cossus* sp., are injurious to lanzones (*Lansium domesticum*) in the Philippines, where the fruits of this tree are an important crop. Old trees are preferred, and the damage, though it does not reach the cambium, is sufficient to lower production and is aggravated by drought. In tests on control in 1955 and 1957, dieldrin, parathion, γ BHC, DDT, EPN and endrin were applied 8–10 times in sprays at various concentrations, and the results, which are given in detail, showed that all were effective, EPN giving much the greatest reduction in the numbers of new tunnels or larvae, and endrin and EPN the greatest increases in yield.

Puzzi (D.) & Orlando (A.). **Principais pragas dos pomares cítricos. Recomendações para o contrôle.** [The principal pests of *Citrus* orchards. Recommendations for control.]—*Biológico* **25** no. 1 pp. 1–20, 18 figs., 13 refs. São Paulo, 1959.

Citrus in São Paulo is attacked by about 25 different species of insects and mites. The most important are fruit-flies (*Ceratitis capitata* (Wied.)

and *Anastrepha mombinpraeoptans* (Seín)), *Phyllocoptruta oleivora* (Ashm.), various Coccids, *Toxoptera* (*Aphis*) *citricidus* (Kirk.), stem borers (*Macropophora accentifer* (Ol.) and *Diploschema rotundicolle* (Serv.)), the adults of *Macrodactylus* spp., and a wild bee, *Melipona ruficrus* (Latr.), and information is given on their bionomics and control.

DE FIGUEIREDO jr. (E. R.), PUZZI (D.) & ORLANDO (A.). **Ensaios de laboratório para verificar a eventual resistência da broca do café ao BHC.** [Laboratory tests on the possible resistance of the coffee borer to BHC.]—*Biológico* **25** no. 1 pp. 21–24, 1 graph, 1 ref. São Paulo, 1959.

Reports of the failure of BHC dusts to control the coffee borer [*Stephanoderes hampei* (Ferr.)] in São Paulo have been received in recent years, and high infestation has also been recorded in Paraná. In tests on the possible development of resistant strains of the Scolytid, adult females from three properties in São Paulo on which control had been practised for about ten years were confined for 48 hours on coffee berries that had been dusted with 0·125–0·5 per cent. γ BHC, and the results were compared with those obtained by Lepage & Giannotti using the same technique some years previously [*R.A.E.*, A **41** 253–254]. The comparison indicated that the beetle had not become resistant to the insecticide, and a test in which a 1 per cent. dust was used in the field resulted in complete control.

BURKHARDT (C. C.). **Increasing sorghum stands in field tests by controlling thief ants and other insect pests.**—*J. econ. Ent.* **52** no. 3 pp. 365–368, 5 refs. Menasha, Wis., 1959.

Field tests on the protection of sorghum from insects and fungi were carried out in Kansas in 1956–58, mainly in areas known to be infested by *Solenopsis molesta* (Say), *Agonoderus lecontei* Chaud. or other insects attacking the sown seeds.

In 1956, mixing the seed in a rotating barrel with 2 oz. 50 per cent. wettable dieldrin powder per 100 lb. resulted in 180 per cent. increase in plant stand in plots infested by *Solenopsis*, and, in 1957, similar treatment with 2·5 oz. combined fungicide and insecticide (60 per cent. captan and 15 per cent. dieldrin), 1·5 oz. insecticide (dieldrin or heptachlor) or 1 oz. of the fungicide Ceresan M (N-(ethylmercuri)-p-toluenesulphonanilide) per 100 lb. increased the stands by 38–300, 98–225 and 16 per cent., respectively, in fields infested mainly by *Solenopsis*, but also by *A. lecontei* and a few wireworms; applications of the mixture to seeds of 14 varieties of grain sorghum resulted in stand increases of 26–368 per cent.

In 1958, when the insects were very injurious and caused more damage than fungi, the addition of 1 oz. dieldrin or heptachlor to 2 oz. captan per 100 lb. seed increased the stand by 211 or 216 per cent. over that obtained from captan alone, and treatment with 1 oz. lindane [almost pure γ BHC], heptachlor or dieldrin was as effective when they were used alone as when they were combined with fungicide, giving 400–571 per cent. increase over treatment with Panogen (cyano(methylmercuri)guanidine) alone. Records for one test showed yields averaging 12, 46 and 63 bushels per acre, respectively, for seed treatment with fungicide, insecticide and both. Soil treatment with 3 lb. aldrin or heptachlor or 1·5 lb. dieldrin per acre in emulsion concentrates, sprayed and disked in just before sowing, caused 112–159 per cent. increase in stand when the seed was not treated, and similar treatment with 2 lb. aldrin or heptachlor or 1·5 lb. dieldrin resulted in

500–514 per cent. increase when the seed had been treated with Panogen. Soil treatment resulted in more vigorous plants and controlled a heavy infestation of chinch bugs [*Blissus leucopterus* (Say)].

Maxwell (F. G.) & Painter (R. H.). **Factors affecting rate of honeydew deposition by** *Therioaphis maculata* **(Buck.) and** *Toxoptera graminum* **(Rond.).**—*J. econ. Ent.* **52** no. 3 pp. 368–373, 3 figs., 11 refs. Menasha, Wis., 1959.

The following is based on the authors' abstract. Factors affecting the rate of honeydew deposition by *Toxoptera graminum* (Rond.) and *Therioaphis maculata* (Buckt.) were studied in an insectary and greenhouse in Kansas, and the reactions of the two species compared. A method was developed whereby honeydew droplets from one apterous adult, feeding for 24 hours on a plant part, were caught on the bottom or sides of a plastic cage and counted.

The rate of deposition was affected significantly in both species by the temperature, the plant part (leaf, stem or petiole), the variety of plant and the amount of light reaching the plant and the feeding site. When *Toxoptera* fed on a barley leaf, yellowing of the leaves by age and reduction of soil moisture significantly reduced the rate of honeydew deposition, which was also affected by the position on the leaf, but reduced moisture and variations in the distances of the leaves from the growing point did not affect that by *Therioaphis* on lucerne.

The rate of deposition by *Toxoptera* on two varieties of barley and one of wheat exceeded that by *Therioaphis* on the varieties of lucerne tested, implying that the problems resulting from honeydew might be as great on barley and wheat as on lucerne if it were not for the differences in cultivation and harvesting time. The rate of deposition was found to be influenced almost directly in proportion to the known amount of resistance to infestation in the food-plants; this suggests that the rate of deposition of honeydew by aphids may be used to measure the degree of resistance of their food-plants to them, the rate of ingestion of plant material and the metabolic activity of the insects.

Fullmer (O. H.), Kurtz (E. A.) & Wade (W. H.). **Two new phosphate-oil combinations for scale control on deciduous fruit trees in the dormant period.**—*J. econ. Ent.* **52** no. 3 pp. 373–376, 5 refs. Menasha, Wis., 1959.

The results are given of experiments in which sprays of oil emulsion with Phostex (a mixture of bis(dialkyloxyphosphinothioyl)disulphides) or ethion were tested in dormant applications for the control of Coccids on deciduous fruit trees in California in 1956–58. Quantities given are per 100 U.S. gal. spray. In tests against *Lecanium cerasifex* (Fitch) (*corni*, auct.) and *L. pruinosum* (Coq.) on prune and *L. cerasifex* on peach or apricot, mixtures of 0·16–0·5 lb. ethion and 1–2 U.S. gal. oil and of 1·2 lb. Phostex with 2 U.S. gal. oil, applied between December 1957 and early March 1958, resulted in more than 97 per cent. mortality, as also did 3 U.S. gal. dormant oil without toxicant against *L. pruinosum*, but 0·65 lb. Phostex with 1 U.S. gal. oil killed only 90 per cent.

In sprays applied to peach, almond and prune between October and early February in 1956–58, mixtures of 0·19–0·38 lb. ethion with 0·5–1 U.S. gal. oil resulted in 87·8–96·5 per cent. kill of *Quadraspidiotus* (*Aspidiotus*) *perniciosus* (Comst.), 0·28–0·47 lb. ethion with 2 U.S. gal. oil in 99·4–99·7

per cent. and 0·56 lb. ethion with 1·5 U.S. gal. oil in 99·7 per cent., indicating the interdependence of the chemical and the oil. Mixtures of 1·2 lb. Phostex with 1·5 U.S. gal. oil resulted in about 97 per cent. dead scales, whereas 1·2–1·5 lb. Phostex with 2 U.S. gal. oil resulted in more than 99 per cent. and seemed to be the optimum rates for use against *Q. perniciosus*; 5 U.S. gal. oil alone and a mixture of 0·5 lb. parathion with 2 U.S. gal. oil were also highly effective, and 0·75 lb. malathion with 2 U.S. gal. rather less so.

In applications made in late January or early February in 1957 or 1958, 0·5 lb. ethion with 3 U.S. gal. oil resulted in 97·7–100 per cent. mortality of *Parlatoria oleae* (Colv.) on peach, control was not improved by increasing the quantities to 0·75 lb. and 3·5 U.S. gal., and 0·75 lb. ethion with 2 U.S. gal. oil resulted in only 82·5–92·7 per cent. mortality. Mixtures of 1·6–2·4 lb. Phostex with 3–3·5 U.S. gal. oil gave 96–100 per cent. mortality, and 0·5 lb. Trithion or parathion with 3 U.S. gal. oil gave comparable results, whereas 0·75 lb. Trithion with 1·5 U.S. gal. oil was less effective and 4 U.S. gal. oil alone, applied in February 1956, gave very little control.

Kurtz (E. A.) & Fullmer (O. H.). **Two new phosphates for control of overwintering eggs of aphids and mites on deciduous fruit trees.**—*J. econ. Ent.* **52** no. 3 pp. 377–379, 8 refs. Menasha, Wis., 1959.

Sprays of oil emulsion with Phostex (a mixture of bis(dialkyloxyphosphinothioyl)disulphides) or ethion, applied to apple or prune trees at the delayed-dormant stage in California in 1956 and 1957, gave excellent control of aphids and mites, and more detailed tests of applications at the dormant and delayed-dormant stages were made in January–March 1958. Quantities given are per 100 U.S. gal. spray.

On apple, 0·62 lb. Phostex or 0·16 lb. ethion with about 1 U.S. gal. oil did not give satisfactory control of either *Anuraphis roseus* Baker or *Panonychus ulmi* (Koch) when applied at the dormant stage, but 0·32 lb. ethion with 2 U.S. gal. oil at this stage and all these combinations and also one of 0·4 lb. DNC with 3·2 U.S. gal. oil at the delayed-dormant stage were effective against both pests, with no differences between them. On prune, dormant and delayed-dormant applications of 0·16 lb. ethion with 0·8 U.S. gal. oil and delayed-dormant applications of 0·62 lb. Phostex with 0·8 U.S. gal. oil gave excellent control of *Hyalopterus pruni* (Geoffr.), *P. ulmi* and *Bryobia practiosa* Koch, whereas a dormant application of Phostex and oil was ineffective, and delayed-dormant applications of 0·16 lb. ethion or 0·62 lb. Phostex with 1·3 U.S. gal. oil and of 0·4 lb. DNC with 3·4 U.S. gal. oil gave excellent control of the aphid and excellent, poor and moderate control, respectively, of *B. practiosa*. On cherry, dormant and delayed-dormant applications of 0·16 lb. ethion or 0·62 lb. Phostex with 0·8 U.S. gal. oil all gave excellent control of *Myzus cerasi* (F.), but both applications of ethion were more effective than those of Phostex against the two mites.

Mallis (A.), Miller (A. C.) & Hill (R. C.). **The attraction of stains to three species of fabric pests.**—*J. econ. Ent.* **52** no. 3 pp. 382–384, 6 refs. Menasha, Wis., 1959.

The following is based on the authors' abstract. In the experiments described, large and small larvae of *Tineola bisselliella* (Humm.) were attracted to parts of woollen cloth stained with human urine, human sweat, tomato juice, milk, beer, black coffee and beef gravy more than to the unstained parts. Small larvae of *Anthrenus flavipes* Lec. also fed on such

stains, but those of *Attagenus megatoma* (F.) (*piceus* (Ol.)) were less attracted to them. Large larvae of *A. megatoma* showed no preference for the stained areas, but those of *Anthrenus* were attracted to beer and tomato-juice stains and showed an occasional preference for the others. Cloth stained with butter, tea, cola soft drink and 5 per cent. sugar solution did not attract any of the larvae. In similar tests on synthetic fabrics under starvation conditions the larvae of *Anthrenus* fed on stained nylon and Dacron, damaging the fabrics, and those of *Attagenus* on nylon stained with human sweat; none of the species fed on stained Orlon or Dynel.

Stephens (S. G.). **Laboratory studies of feeding and oviposition preferences of *Anthonomus grandis* Boh.**—*J. econ. Ent.* **52** no. 3 pp. 390–396, 2 graphs, 5 refs. Menasha, Wis., 1959.

The following is substantially the author's abstract. Adults of *Anthonomus grandis* Boh. that were offered the choice of flower buds from two strains of Upland cotton in cups in a cage found those of one of them (no. 50), which possesses the normal complement of resin glands and two genetic factors for hairiness, more readily than those of the other (no. 6), which is completely glandless and has glabrous buds; the reaction was shown both in continuous light and in the dark and was not affected by removal of the conspicuous bracteoles [*cf. R.A.E.*, A **46** 338]. There was no significant difference in the ability of the weevils to feed and oviposit on the two strains when no choice was offered, but those offered a choice showed a marked preference for feeding on no. 6 and for ovipositing on no. 50; the feeding preference became weaker as the food supply was used up.

It is provisionally suggested that the presence of glands is an important factor in attracting the weevils to the cotton plant and probably in stimulating oviposition, though it has little effect on feeding, and that hairiness of the flower buds discourages feeding when glabrous buds are also available.

Hacskaylo (J.) & Scales (A. L.). **Some effects of Guthion alone and in combination with DDT and of a dieldrin-DDT mixture on growth and fruiting of the cotton plant.**—*J. econ. Ent.* **52** no. 3 pp. 396–398, 1 graph, 4 refs. Menasha, Wis., 1959.

In view of apparent delay in the development of bolls on cotton sprayed with Guthion in Texas in 1955, plants were grown under insect-free conditions in the greenhouse and treated nine times at weekly intervals, until the first boll opened, with 15 U.S. gal. spray per acre containing 0·25, 0·5 or 1 lb. Guthion or mixtures of 0·25 lb. Guthion or dieldrin with 2 lb. DDT.

The plants sprayed with 0·25 lb. Guthion alone produced more flowers than untreated ones or those treated with the mixtures, whereas dieldrin with DDT reduced and retarded flower formation, boll setting and plant growth, but hastened plant maturity. All the insecticides but 0·25 lb. Guthion reduced the final dry weight of the plants, though only the mixtures killed plant parts, and all reduced boll size and yield of seed cotton; the reduction in yield was greatest for DDT with dieldrin and not significant for Guthion alone. The time required for bolls to mature was essentially the same for all treatments. The lower rates of Guthion delayed plant maturity and increased the production of bolls. None of the treatments had an adverse effect on fibre quality, although some coarsening was evident.

It is considered possible that field-grown plants might be less affected by the insecticides, owing to wind drift and other environmental factors [*cf. R.A.E.*, A **46** 48], and that the protection against insects would compensate for any reduction in growth or yield.

ROUSSEL (J. S.), BLUM (M. S.) & EARLE (N. W.). **Joint action of DDT and other chlorinated hydrocarbon insecticides against resistant boll weevils.** —*J. econ. Ent.* **52** no. 3 pp. 403–409, 5 graphs, 6 refs. Menasha, Wis., 1959.

The following is substantially the authors' abstract. The joint action of DDT in combination with toxaphene, endrin or γ BHC (lindane) against strains of *Anthonomus grandis* Boh. differing in susceptibility to the individual insecticides [*cf. R.A.E.*, A **46** 344] was studied in the laboratory. Weevils that had been collected from cotton were treated topically with acetone solutions or exposed to deposits in petri dishes for mortality studies, and the penetration and metabolism of DDT were studied in tests in which it was applied alone or with other insecticides. The mixtures showed only additive effects when applied to weevils of a strain susceptible to chlorinated hydrocarbons; when resistant weevils were used, the mixture of toxaphene and DDT showed synergism, but mixtures of endrin or γ BHC with DDT only additive effects. The penetration of the insects by DDT appeared to be equal for all strains. Separate applications of toxaphene and DDT to different sites on the weevil were as effective as a single application of the mixture, and DDT applied as much as 96 hours after treatment with toxaphene caused high mortality, whereas repeating the applications of toxaphene failed to cause much increase in kill. The weevils did not metabolise DDT so rapidly when treated with the mixture as when treated with DDT alone; the fate of toxaphene in the insects is unknown. Although the mixture of toxaphene and DDT showed a synergistic activity against the resistant weevils, the combination was not as effective against them as was toxaphene alone against the susceptible strain.

CHIANG (H. C.) & HODSON (A. C.). **Summer pupation of the European corn borer and the seasonal temperature.**—*J. econ. Ent.* **52** no. 3 pp. 409–411, 1 graph, 4 refs. Menasha, Wis., 1959.

Ostrinia (*Pyrausta*) *nubilalis* (Hb.) overwinters as a full-fed larva, and larvae of the first generation, which develop in summer, either pupate in the same year and transform to adults that give rise to a second generation, or enter diapause and do not pupate until the next spring. Records obtained from maize in southern Minnesota in 1948–58 showed that 92–100 per cent. pupated in summer in two years in which the temperature was above the average, as shown by the cumulative total of day-degrees over 50°F. from early spring [*cf. R.A.E.*, A **41** 146], and only 5·5–10 per cent. in three years in which it was below the average. The percentages that pupated in the other years fell in an intermediate range, but did not always precisely correspond with the temperature patterns, probably owing to the many other factors involved.

The results suggest that the extent of summer pupation, which normally does not become apparent until August, can be estimated well in advance on the basis of temperature, at least to the extent of predicting whether it will be extremely high or extremely low, and this, combined with a

knowledge of the population level in July, will enable the potential second-generation infestation to be predicted.

Carlson (E. C.). **Control of *Macrosiphum barri* Essig and its damage to lettuce seed plants.**—*J. econ. Ent.* **52** no. 3 pp. 411–414, 1 ref. Menasha, Wis., 1959.

Macrosiphum barri Essig [*cf. R.A.E.*, A **40** 65] damages lettuce grown for seed in the Sacramento Valley of California, and investigations on its control were carried out in 1956. Plants sown on 10th March were sprayed on 16th and 29th April, 11th and 28th May and 12th and 27th June and dusted on 13th July and 1st August, and counts on 3rd and 6th August showed that all treatments gave significant control of the aphid and also of *Tetranychus telarius* (L.); 1 lb. parathion and 0·5 lb. demeton in 50 U.S. gal. spray per acre, followed by dusting with 40–50 lb. 2 per cent. parathion and with 10 per cent. DDT with 4 per cent. malathion per acre, respectively, were slightly better, and 1 lb. parathion in sprays with no dust applications slightly worse, than 0·5 lb. lindane [almost pure γ BHC] or demeton in the sprays, followed by dusts containing 1 per cent. γ BHC with 4 per cent. malathion and 1 per cent. γ BHC alone, respectively. All resulted in very significant increases in yield and in size and weight of seed; the combination of parathion sprays and dusts trebled the yield and was significantly better than any other. In the dusts, parathion and DDT gave better supplementary control than γ BHC. It was found that *M. barri* could cause as much as 66 per cent. loss of seed. The first four spray applications of parathion and γ BHC reduced the incidence of lettuce mosaic, which is apparently spread primarily by *Myzus persicae* (Sulz.) early in the season, but not enough to give practical control.

In 1957, artificial infestation of plants forming seed-heads in field-cages with 1, 4 or 8 apterae of *Macrosiphum barri* on 26th July resulted in 42–59 per cent. loss of seed by 20th September and in reductions in its weight and size. Aphid feeding, even at the lowest level of infestation, caused significant reductions in the percentage germination and in the mean germination period of the seed from infested plants, and resulted in increases in a damaged condition of the cotyledons referred to as ' red cotyledon '.

Strong (R. G.) & Lindgren (D. L.). **Effect of methyl bromide and hydrocyanic acid fumigation on the germination of oats.**—*J. econ. Ent.* **52** no. 3 pp. 415–418, 7 refs. Menasha, Wis., 1959.

Samples of two varieties of oats, with moisture contents adjusted to 8, 10, 12 and 14 per cent., were fumigated for 72 hours with various dosages of methyl bromide at temperatures of 50, 70 and 90°F., and samples of one were treated with methyl bromide and hydrogen cyanide under various conditions of temperature, exposure and dosage. Half the samples were fumigated once and half twice, and germination tests were made within five days of fumigation and after 84 days of storage at 50°F. Under the conditions used, fumigation with 1–3 lb. HCN per 1,000 cu.ft. did not affect germination, and the oat seeds were more tolerant of methyl bromide than wheat had been [*cf. R.A.E.*, A **48** 218], but less so than barley [*cf.* **48** 301]. Increases in methyl-bromide dosage (between 1 and 6 lb.), exposure period (between 2 and 72 hours), temperature and moisture content contributed slightly to decreases in germination after fumigation, whereas varietal difference did not seem to affect it. A repetition of fumigation reduced

germination in some cases. No significant difference in germination was observed when the fumigated oats were stored.

Swenson (K. G.) & Nelson (R. L.). **Relation of aphids to the spread of cucumber mosaic virus in gladiolus.**—*J. econ. Ent.* **52** no. 3 pp. 421–425, 31 refs. Menasha, Wis., 1959.

Cucumber mosaic virus causes a white-break disease of *Gladiolus* in Oregon. Examination of 500 plants 12–24 in. high in each of seven fields at widely separated points in the Willamette Valley on six occasions in 1957 revealed the presence of only 240 wingless aphids, and observations in 1956 and 1958 confirmed the virtual absence of colonisation. Alates totalling 297 individuals of at least 18 species were found on the plants, and this suggests that the spread of the virus is largely due to migrating aphids. Tests with a type strain of the virus and with one isolated from *Gladiolus* resulted in transmission by six species not previously recognised as vectors; a survey of the literature showed that negative reports on transmission by some species were based largely on inadequate tests, and it is concluded that probably most of the colonising or migrating aphids found on a herbaceous crop susceptible to the virus would be able to transmit it. The transmissibility of an isolate of the virus from *Daphne* was either lost in about nine months or reduced to a level not detectable by tests involving 1,100 examples of *Myzus persicae* (Sulz.), which had transmitted it in the earlier tests.

Fenton (F. A.). **The effect of several insecticides on the total arthropod population in alfalfa.**—*J. econ. Ent.* **52** no. 3 pp. 428–432, 6 refs. Menasha, Wis., 1959.

The following is based on the author's summary. In tests carried out in Oklahoma, in which 3 lb. toxaphene or 0·25 lb. parathion, endrin or demeton in 40 U.S. gal. spray per acre was applied to small plots of lucerne on 26th April and 10th June 1954 and 8th July 1955 and 0·5 lb. malathion in 8 U.S. gal. spray per acre to a lucerne field on 3rd May 1955, all treatments caused marked reductions in the total numbers of arthropods on the plants. These were mainly phytophagous and entomophagous insects, but included pollen and nectar feeders and scavengers. Analysis of the data for the first two classes showed that reductions were greater for the phytophagous than for the entomophagous species. The specificity of certain of the insecticides caused marked changes in the components of the populations, and the toxic effects of some of the insecticides to certain insect predators created favourable conditions for their prey, which became more numerous in sprayed than in unsprayed plots later in the season. Residual effects were limited, owing to migration into or between plots. Toxaphene was generally less effective than the other materials, and parathion was the most and endrin the least toxic to some of the beneficial species.

Cutright (C. R.). **Rotational use of spray chemicals in insect and mite control.**—*J. econ. Ent.* **52** no. 3 pp. 432–434, 2 refs. Menasha, Wis., 1959.

Records of the spray schedules applied in apple orchards in Ohio over 15 years and their effectiveness against various pests showed that growers

who made frequent changes in the chemicals used obtained the best control, especially of mites; when treatments were restricted to one acaricide for several seasons, resistant populations of mites, which did much damage before their presence was suspected, always developed. These results and those obtained in a special study of three experimental orchards at Wooster showed that the development of resistance by fruit-tree mites could be greatly retarded and possibly prevented by the rotational use of chemicals with different killing actions. These comprised materials based on phosphorus, the dinitro compounds, oil emulsions, glyodin, Kelthane and chlorobenzilate, DMC (Dimite), and compounds based on sulphur, and frequent changes from one to another of these groups result in the death of any members of a population that are potentially resistant to one of them before actual resistance appears. The principle of rotation of treatments applies to both insects and mites and should become increasingly useful as more species tend to develop resistance to individual classes of compounds.

Metcalf (R. L.), Reynolds (H. T.), Winton (M.) & Fukuto (T. R.). **Effects of temperature and plant species upon the rates of metabolism of systemically applied Di-Syston.**—*J. econ. Ent.* **52** no. 3 pp. 435–439, 5 figs., 6 refs. Menasha, Wis., 1959.

In tests in which fresh cotton leaves were immersed in a 0·1 per cent. colloidal suspension of O,O-diethyl S-2-(ethylthio)ethyl phosphorodithioate (Di-Syston) labelled with ^{32}P, exposed to sunlight for 30–60 minutes to permit the uptake of enough radioactive material for measurement, and then kept with their petioles in distilled water at constant temperatures of 37–100°F. and under constant artificial light, paper chromatography of extracts from them after 1–7 days showed that the four expected metabolites were produced [*cf. R.A.E.*, A **46** 229], and that increase in temperature accelerated the formation of the two highest oxidation products, O,O-diethyl S-2-(ethylsulphonyl)ethyl phosphorodithioate and phosphorothioate. It was calculated that the rate of oxidation of the initial product, O,O-diethyl S-2-(ethylsulphinyl)ethyl phosphorodithioate, which appeared very rapidly at temperatures above 70°F., was almost doubled for each rise in temperature of 10°C. [18°F.], and similar effects may be presumed for the subsequent oxidative reactions. Similar tests at a constant temperature of 70°F. showed that metabolism of the sulphinyl dithioate and hydrolytic decomposition of the toxic products was 2–3 times as rapid in tomato as in cotton, and that the rates were intermediate in other plants.

It is pointed out in a discussion of these results that the persistence of toxic residues of the parent compound will vary with plant species and with prevailing temperatures. Cool weather prolongs it, but also reduces the rate of plant growth, thus postponing the period of crop maturity, so that the residue problem may not be so great as sometimes thought. Warm weather has the opposite effect, and sudden changes in temperature may have a great effect on residues when applications are made towards harvest.

Dickson (R. C.) & Laird jr. (E. F.). **California desert and coastal populations of flying aphids and the spread of lettuce-mosaic virus.**—*J. econ. Ent.* **52** no. 3 pp. 440–443, 11 refs. Menasha, Wis., 1959.

The virus of lettuce mosaic, which is seed-borne to some extent but mainly transmitted by aphids, is injurious in coastal areas of California,

where lettuce is sown in August–February, but not in the irrigated desert, where it is sown in September–December, although flying aphids are apparently more numerous in autumn there than on the coast. Investigations were therefore carried out in a desert and a coastal area, in Imperial and Ventura counties, respectively, on the size and composition of the aphid population during the lettuce-growing seasons and their effects on the incidence of the disease. The aphids were trapped on adhesive boards hung 5 ft. above the ground at the edges of lettuce fields, and of ten species that were numerous and were tested for transmission of the virus in the greenhouse, *Macrosiphum barri* Essig, *M. euphorbiae* (Thos.) (*solanifolii* (Ashm.)) and *Myzus persicae* (Sulz.), which commonly breed on lettuce, were efficient vectors, and *Amphorophora lactucae* (L.) (*sonchi* (Oestl.)) and *Aphis gossypii* Glov., which do not, were inefficient vectors. Catches in the winters of 1953–54 and 1954–55 showed that the populations of flying aphids were about 12 times as high in the desert as on the coast, but that efficient vectors, notably *M. persicae*, were virtually absent from the desert during the autumn and early winter, whereas they were present every month from September to March on the coast. Although *A. gossypii* transmitted the virus in the laboratory, large autumn populations in the desert did not spread the disease.

Strong (R. G.), Pieper (G. R.) & Sbur (D. E.). **Control and prevention of mites in granary and rice weevil cultures.**—*J. econ. Ent.* **52** no. 3 pp. 443–446, 3 refs. Menasha, Wis., 1959.

When laboratory cultures of *Sitophilus granarius* (L.) in California were invaded by *Typhlodromus* sp., several acaricides were tested for elimination of the mites without undue harm to the insects. Preliminary tests with flour mixtures indicated that Kelthane was the most effective against the mite, followed in order by chlorobenzilate, chlorfenson (ovex), Tedion and Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite]. Caging adults of *S. granarius* and *S. oryzae* (L.) on residues of the acaricides showed that Aramite was non-toxic and Tedion extremely toxic to them, with the other materials intermediate in effect; Kelthane showed considerable toxicity to the weevils and introducing this compound, chlorobenzilate or chlorfenson in the water used to bring the wheat to the required moisture content led to increased weevil mortality. Investigations on a safe method of applying Kelthane showed that covering culture jars with cloths that had been soaked in a Kelthane emulsion concentrate and dried had no obvious effect on the weevils, but that mixing 2 gm. 18·5 per cent. wettable powder per U.S. quart with the wheat and leaving it for 24 hours before sieving and cleaning twice left enough Kelthane to harm emerging adults, unless the wheat was also washed and dried.

An invasion of cultures of both weevils by *Acaropsis* sp., which also attacked other insects, was treated by removing culture and test material and spraying the infested areas with a 1:1 mixture of 18·5 per cent. Kelthane and 25 per cent. chlorobenzilate emulsion concentrates, aerating for two days and covering the shelves with Kelthane-treated cloths; covering cultures other than those of the weevils with treated cloths and returning them to the rearing area; destroying heavily infested cultures containing adult weevils and covering others with treated cloths; and mixing Kelthane powder in the wheat of immature cultures for 24 hours before cleaning, washing, drying and covering with treated cloths. The last treatment was also used after removing parent weevils from new cultures until mite-free wheat was available for parent weevils. These treatments

eradicated the mite, and Kelthane-treated cloths were subsequently used on all laboratory cultures of stored-product pests as a precaution.

Cole (M. M.), LaBrecque (G. C.) & Burden (G. S.). **Effects of gamma radiation on some insects affecting man.**—*J. econ. Ent.* **52** no. 3 pp. 448–450, 8 refs. Menasha, Wis., 1959.

The results are given of experiments carried out at Orlando, Florida, to provide information on the amount of γ-radiation from radioactive cobalt (^{60}Co) required to kill certain insects affecting man. The species used [*cf. R.A.E.*, B **48** 165] included *Thermobia domestica* (Pack.) and *Monomorium pharaonis* (L.), and the doses needed to give 50 per cent. and (in brackets) complete mortality were 92,000 (127,500) and 98,000 (120,000) r for nymphs and adults (both sexes) of *T. domestica* and 140,000 (225,000) and 190,000 (210,000) r for workers and queens of *M. pharaonis*.

Arthur (B. W.) & Hyche (L. L.). **Soil applications of insecticides for control of tobacco thrips on peanuts.**—*J. econ. Ent.* **52** no. 3 pp. 451–452, 7 refs. Menasha, Wis., 1959.

The following is based on the authors' abstract. Experiments on the control of *Frankliniella fusca* (Hinds) on groundnuts were carried out in Alabama in 1952–56. Aldrin and dieldrin in granules applied to the soil at 2 lb. technical compound per acre before sowing were significantly more effective in controlling the thrips on the seedlings than was 2 lb. endrin, heptachlor or lindane [almost pure γ BHC] or 6 lb. toxaphene in granules or 4 lb. DDT in a dust; the residual effects of aldrin and dieldrin were greater on clay than on sandy soil. Phorate (Thimet) and O,O-diethyl S-2-(ethylthio)ethyl phosphorodithioate (Di-Syston) at 2·5 and 5 lb. per acre, respectively, in dusts applied to the soil, were significantly more effective than the aldrin granules. Plants growing on plots treated with the dusts gave higher yields than those on untreated plots, but the gains were not significant.

Wright (C. G.). **Beetles found in yellow pine floor joists of buildings in North Carolina.**—*J. econ. Ent.* **52** no. 3 p. 452, 2 refs. Menasha, Wis., 1959.

When samples of infested yellow pine from floor joists in North Carolina were kept in the laboratory at constant temperature, *Xyletinus peltatus* (Harris) emerged from ten collected in localities distributed throughout the State, *Hadrobregmus carinatus* (Say) from one from the north-east, and *Rhyncolus* (*Hexarthrum*) *ulkei* (Horn) from three from north-central areas.

Fye (R. E.), McMillian (W. W.), Hopkins (A. R.) & Walker (R. L.). **Longevity of overwintered and first generation boll weevils at Florence, S.C.**—*J. econ. Ent.* **52** no. 3 pp. 453–454, 2 refs. Menasha, Wis., 1959.

In tests in South Carolina in 1956–57, overwintered adults of *Anthonomus grandis* Boh. caged on cotton in the field survived for 1–141 days, with an average of about 20 days; fat analyses showed that those containing most

crude lipids lived the longest. Under similar conditions, adults of the first generation lived for 9–115 days, with an average of about 41 days, but there was no correlation of lipid content with longevity.

Hays (S. B.) & Hays (K. L.). **Food habits of** *Solenopsis saevissima richteri* **Forel.**—*J. econ. Ent.* **52** no. 3 pp. 455–457, 6 refs. Menasha, Wis., 1959.

The following is based on the authors' abstract. Investigations were made in Alabama in 1957 to determine the food habits of *Solenopsis saevissima richteri* Forel [*cf. R.A.E.*, B **27** 102; A **38** 34]. Ant mounds were dissected in the field for observation of mound structure, the kinds and amounts of food stored and methods of storage, and ants were observed at work to find what food materials were collected. It was found that the diet was varied, but that the primary component was insects, either alive or dead. The ants were observed to tend aphids and Coccids, and in only one instance were they observed feeding on plant material in the field, though they were seen carrying seeds to the nest. When kept without food for several days in the laboratory, ants fed on seedling plants of a few species, but most colonies became cannibalistic when confined to plant material.

Pimentel (D.) & Weiden (M. H. J.). **Protection of stored woolens from insect damage.**—*J. econ. Ent.* **52** no. 3 pp. 457–460, 18 refs. Menasha, Wis., 1959.

In the United States, woollen garments stored during the summer are liable to attack by *Tinecola bisselliella* (Humm.) and *Attagenus megatoma* (F.) (*piceus* (Ol.)), and various methods of protecting them from infestation were tested. It was found that neither species could chew through a thin film of polyethylene plastic or heavy wrapping paper, and that bags, preferably of the plastic, with airtight fastenings, gave complete protection. Fumigation with formaldehyde or p-dichlorobenzene was effective against adults of *Tinecola*, but not against larvae of *Attagenus*, these being the stages that normally gain entrance. Examination of *Attagenus* larvae 14–35 days after they had been confined for 45 minutes on the dried residues from solutions of 5 per cent. DDT or methoxy-DDT (methoxychlor), 2 per cent. chlordane, 1·25 per cent. lindane [almost pure γ BHC] or 0·5 per cent. dieldrin or diazinon showed that none was very effective. When woollen cloth was impregnated with 5 per cent. DDT or 2 per cent. chlordane, both killed larvae of *Attagenus* that fed on them. Wool treated with chlordane should be dry-cleaned after storage, as the compound is relatively toxic and readily absorbed through the skin, and home washing of babies' clothes or blankets, which may be put into the mouth, is considered inadequate after treatment with either insecticide.

Wallis (R. C.). **Polyhedral bodies from diseased pupae of** *Anisota senatoria* **(J. E. Smith).**—*J. econ. Ent.* **52** no. 3 p. 460, 1 ref. Menasha, Wis., 1959.

Larvae of *Anisota senatoria* (J. E. Smith), which feed on oak, were unusually numerous in south-eastern Connecticut in the summer of 1958. They rapidly exhausted their food-supply in many areas, and being subjected to intense competition and starvation, were forced to feed on unsuitable

foliage. There was heavy mortality in the last instar during the last week in August in one area, and the pupae from larvae that were collected and reared on fresh oak foliage in the laboratory were found to contain virus polyhedra. The virus appeared to be of the cytoplasmic type.

Carlson (E. C.). **Evaluation of insecticides for *Lygus* bug control and their effect on predators and pollinators.**—*J. econ. Ent.* **52** no. 3 pp. 461–466, 12 refs. Menasha, Wis., 1959.

In view of the development of resistance to DDT by species of *Lygus* [*cf. R.A.E.*, A **45** 101], a laboratory method was developed in California in 1956 for testing new insecticides and insecticidal combinations, applied mainly in sprays against these bugs, on the fertilised green seed-heads of potted carrot plants. Quantities given are of actual compound per acre. When adult females were caged on the treated heads, 1 lb. DDT or toxaphene combined with 1 lb. trichlorphon (Dipterex) or malathion gave more rapid mortality and longer residual control than any of the compounds used alone. Malathion and trichlorphon alone gave satisfactory control, but had a shorter period of effectiveness than DDT; 4 lb. Bayer 19639 [O,O-diethyl S-2-(ethylthio)ethyl phosphorodithioate], 1 lb. Thiodan, 0·5 lb. demeton or endrin and a mixture of 1 lb. DDT and 1 lb. Trithion gave promising results.

In small plots treated with a hand duster and fields dusted by aeroplane, 10 per cent. DDT gave satisfactory control of *L. hesperus* Knight on carrot and did not appreciably reduce the numbers of honey bees or increase those of *Tetranychus telarius* (L.); DDT applied at 1 lb. per acre with a knapsack sprayer gave similar results. Trichlorphon and malathion, applied at 1 lb. per acre in sprays, and a dust of 5 per cent. trichlorphon, gave satisfactory control of *L. hesperus* and caused no increase in mites, but had a less prolonged effect than DDT. A dust containing 10 per cent. DDT and 5 per cent. trichlorphon, applied with a hand duster or by aeroplane, caused significantly higher *Lygus* mortality than DDT alone and did not increase numbers of mites or reduce those of honey bees; 10 per cent. toxaphene with 5 per cent. trichlorphon was also more toxic than DDT, but this mixture and mixtures of toxaphene or DDT with 4 per cent. malathion caused an increase of mites and were more toxic to some of the predators present, notably *Orius tristicolor* (White).

Magee (W. J.) & Davenport (M. G.). **The effect of spray nozzle arrangement and gallonage on control of the pink bollworm and other cotton insects.**—*J. econ. Ent.* **52** no. 3 pp. 466–467, 5 refs. Menasha, Wis., 1959.

Investigations in Texas in 1954 and 1955 in which cotton was treated with a combination of 0·3 lb. dieldrin and 3 lb. DDT per acre, applied 3–5 times at weekly intervals in 20 lb. dust or in various quantities of emulsion spray, with different nozzle arrangements and numbers of nozzles, showed that all treatments were equally effective in reducing populations of *Pectinophora gossypiella* (Saund.), though none significantly affected the yield. Treatment with 0·4 lb. endrin with 2 lb. DDT in 2–11 U.S. gal. spray per acre with various numbers and arrangements of nozzles 14 times in August–October 1956 tended to reduce the populations of *P. gossypiella*, *Heliothis zea* (Boddie) and *Anthonomus grandis* Boh., though not usually

significantly, and increased the yields of seed cotton significantly. Differences between treatments were significant in only one instance, and it is concluded that one no. 2 nozzle per row on 40-inch row centres, delivering 2 U.S. gal. insecticide per acre, was as effective as any other nozzle arrangement and gallonage tested. Broad-jet nozzles appeared promising, but need additional testing.

Arthur (B. W.), Hyche (L. L.) & Mount (R. H.). **Control of the red-necked peanutworm on peanuts.**—*J. econ. Ent.* **52** no. 3 pp. 468–470, 4 refs. Menasha, Wis., 1959.

Larvae of *Stegasta basquecella* (Chamb.) attacked the unopened leaflets in the terminal buds of groundnuts in Alabama in 1952 and retarded terminal growth; in subsequent years, they were first seen in May–July and became more numerous towards the end of the season, infesting all the terminal buds in some late-sown fields by September. There were at least two generations a year. The larvae usually occurred singly in the buds, though up to five were seen, and they pupated in them.

Tests in 1952–56 showed that 3–4 applications of dusts containing 10 per cent. DDT, 20 per cent. toxaphene, 2 per cent. endrin or dieldrin or 5 per cent. Guthion at 20–25 lb. per acre in July–August gave very good control and that a single application gave significant reductions in bud populations. Dusting with 4 per cent. malathion or 3·75 per cent. heptachlor was less effective, and spraying the foliage with 0·5 lb. demeton, methyl-demeton, schradan or Chlorthion per acre four times during the season or treating the soil in which the plants were grown with 2 lb. aldrin, dieldrin or heptachlor in granules or 2·5 or 5 lb. phorate (Thimet) or Di-Syston [O,O-diethyl S-2-(ethylthio)ethyl phosphorodithioate] in dusts was ineffective. Observations in 1954 showed no significant gains in yield as a result of insect control.

Flock (R. A.) & Deal (A. S.). **A survey of beet leafhopper populations on sugar beets in the Imperial Valley, California, 1953–1958.**—*J. econ. Ent.* **52** no. 3 pp. 470–473, 1 graph, 5 refs. Menasha, Wis., 1959.

Surveys were carried out in the Imperial Valley, California, in 1953–58 to determine whether there were any concentrations of wild food-plants on which *Circulifer tenellus* (Baker), the vector of curly-top virus, could be controlled before it invaded sugar-beet and whether the sugar-beet season could be extended by eliminating the summer beet-free period.

In the first five years, which were dry, most of the leafhoppers and the disease originated in the cultivated areas, on sugar-beet and weeds. Populations were low in the desert areas, and few leafhoppers migrated from these to cultivated areas. This was particularly true in 1956, when there was a severe outbreak of curly-top. During the relatively damp season of 1957–58, a moderate population developed in the uncultivated areas, whereas reproduction was delayed in cultivated ones.

The extreme heat and dryness of the summer in the Imperial Valley reduce the numbers of food-plants and shorten the life of *C. tenellus*. There was a great reduction in numbers at this time each year, and this was greatest when the beet-free period was longest and most complete. It is concluded that controlling wild food-plants in summer and maintaining a beet-free period in July–August are the most important measures for

controlling *C. tenellus* and curly-top in the cultivated area of the Valley, and that the use of insecticides on the remaining weeds during the beet-free period would increase their effectiveness.

Gyrisco (G. G.), Muka (A. A.) & Briant (A. M.). **Studies of flavors and odors of potatoes and red kidney beans grown in rotation with lindane-treated red clover.**—*J. econ. Ent.* **52** no. 3 pp. 473–475, 7 refs. Menasha, Wis., 1959.

Potatoes grown in 1951 and 1952 in New York in a gravelly silt loam soil that had been treated with 1 lb. lindane [almost pure γ BHC] per acre in 1949 and 1950 for the control of the clover root borer [*Hylastes obscurus* (Marsham)] on red clover [*Trifolium pratense*] [*cf. R.A.E.*, A **38** 431] were affected in both flavour and odour, whereas those grown in 1953 were normal. Red kidney beans grown under the same conditions in 1951–53 were not affected.

Rutschky (C. W.). **Ear fertilization and Japanese beetle damage in sweet corn.**—*J. econ. Ent.* **52** no. 3 pp. 475–477, 1 fig., 3 refs. Menasha, Wis., 1959.

Tests in south-eastern Pennsylvania in which the silks of sweet maize were cut 4, 6 or 8 hours after pollination to simulate damage by adults of *Popillia japonica* Newm. [*cf. R.A.E.*, A **35** 53] showed that a period of at least eight hours was needed for the pollen to fertilise the ear completely, and this was confirmed by observations on natural infestations. Moderate infestations appeared to have little or no effect on the marketable quality of the maize, but heavy infestations cause obvious damage, so that protection of the silks for at least eight hours after pollination is necessary.

Young (J. R.) & Ditman (L. P.). **The effectiveness of some insecticides on several vegetable crops.**—*J. econ. Ent.* **52** no. 3 pp. 477–481, 1 ref. Menasha, Wis., 1959.

The following is based on the authors' abstract. In tests in Maryland in 1957, weekly treatment throughout the period of crop growth with 0·28 lb. Thiodan or ethion, 0·44 lb. Sevin, 0·56 lb. malathion, 0·14 lb. Dibrom (dimethyl 1,2-dibromo-2,2-dichloroethyl phosphate) or 0·26 lb. Trithion in 23–29·5 U.S. gal. emulsion spray per acre for the control of pests caused no injury to cucurbits, tomato, potato, snap bean, lima bean, cabbage or egg-plant [*Solanum melongena*]. Yields of egg-plant and cabbage were significantly increased by Thiodan, ethion, malathion, Dibrom and Trithion and those of cabbage also by Sevin, but those of tomato, potato and the cucurbits were not increased by any of the insecticides. All the compounds tested were very effective against *Gargaphia solani* Heid. on egg-plant, *Epicauta pestifera* Werner on egg-plant and potato, *Trichoplusia ni* (Hb.) and *Pieris rapae* (L.) on cabbage, *Empoasca fabae* (Harris) on potato and snap bean and *Epilachna varivestis* Muls. on snap and lima beans. Thiodan was most effective against *Phyllotreta cruciferae* (Goeze) on egg-plant and *Heliothis zea* (Boddie) on tomato, egg-plant and snap and lima beans, and Sevin was effective against *Aphis gossypii* Glov. on a cucurbit, but not against *Macrosiphum euphorbiae* (Thos.) (*solanifolii* (Ashm.)) on egg-plant

and tomato. This aphid was well controlled by Thiodan and Trithion, and *Tetranychus telarius* (L.), on snap and lima beans, by Trithion and ethion. No off-flavours were detected in any of the crops.

Allen (D. G.) & Rudinsky (J. A.). **Effectiveness of Thiodan, Sevin, and lindane on insects attacking freshly cut Douglas-fir logs.**—*J. econ. Ent.* **52** no. 3 pp. 482–484, 2 figs., 3 refs. Menasha, Wis., 1959.

Rudinsky (J. A.) & Terriere (L. C.). **Laboratory studies on the relative contact and residual toxicity of ten test insecticides to** *Dendroctonus pseudotsugae* **Hopk.**—*T.c.* pp. 485–488, 2 graphs, 6 refs.

In the second of these papers, the authors describe laboratory tests carried out in 1958 to determine the contact toxicity of various insecticides to *Dendroctonus pseudotsugae* Hopk. In tests of immediate effect, groups of 15 adults were treated with solutions by a spray-tunnel technique [*cf. R.A.E.*, A **41** 275], and comparison of the LD50's showed that lindane [almost pure γ BHC] was the most toxic material tested, followed in order by Thiodan, isodrin, endrin, Sevin, heptachlor, aldrin, DDT and chlordane, with dieldrin equalling aldrin, whereas at the LD90, Thiodan was the most toxic, followed by endrin, γ BHC, isodrin, Sevin, aldrin, heptachlor, dieldrin, DDT and chlordane. Sevin was more toxic to females than to males, but all other materials showed greater toxicity to the males. For tests of persistence, the beetles were confined for five minutes on rotating blocks of wood fibre, at intervals of up to 13 weeks after the application of wettable-powder sprays to the surfaces. The results showed a gradual decline in the toxicity of endrin, Thiodan and isodrin, which gave about 5–15 per cent. mortality at the end of the test, but complete loss of toxicity in 3–7 weeks for γ BHC, aldrin, heptachlor and chlordane. Dieldrin and Sevin remained toxic for 10–12 weeks, and DDT showed the least loss of all, giving about 70 and 20 per cent. kill, respectively, immediately and 13 weeks after application.

The first paper comprises an account of field tests in Oregon in which the bark on whole trunks of Douglas-fir (*Pseudotsuga menziesii*) was sprayed to run-off with 1 or 3 lb. wettable Thiodan, Sevin or γ BHC per 100 U.S. gal. water immediately after cutting, in May 1958. All treatments but the lower concentration of Sevin gave complete protection against insect attack for at least eight weeks. After 19 weeks, no successful attacks by *D. pseudotsugae* had occurred on bark treated with Thiodan or 3 lb. γ BHC, but that treated with 1 lb. γ BHC or 1 or 3 lb. Sevin showed successful attacks at the rate of 0·2, 0·4 and 0·1 per sq. ft., as compared with 2·3 per sq. ft., with much more extensive galleries, on untreated logs. Attack by other beetles and fungi showed similar reductions, which were least for the weaker Sevin spray, and termites, which were active and causing incipient damage on unsprayed logs, did not attack treated ones.

Madsen (H. F.) & Bailey (J. B.). **Control of the apple aphid and the rosy apple aphid with new spray chemicals.**—*J. econ. Ent.* **52** no. 3 pp. 493–496, 5 refs. Menasha, Wis., 1959.

Orchard tests with new compounds for the control of *Anuraphis roseus* Baker and *Aphis pomi* Deg. on apple were carried out in California in 1957 and 1958.

When applied in dilute delayed-dormant emulsion sprays on 21st March 1957 against the eggs of *Anuraphis*, 3·6 U.S. gal. 5 per cent. ethion or 10

per cent. Phostex (a mixture of bis(dialkyloxyphosphinothioyl disulphides) in miscible-oil formulations and 3·6 U.S. pints 48 per cent. Trithion with 7·2 U.S. gal. dormant oil per acre gave excellent control and did not damage the cover crop; the ethion and Trithion sprays controlled the winter eggs of *Panonychus ulmi* (Koch), but Phostex did not. When applied in either year in emulsion sprays on 6th May to the foliage of trees that had received no dormant treatment, 1 pint 21 per cent. demeton, 48 per cent. phorate (Thimet), 50 per cent. dimethoate or 18 per cent. Di-Syston [O,O-diethyl S-2-(ethylthio)ethyl phosphorodithioate] and 1 quart 25 per cent. Am. Cyanamid 18706 (O,O-dimethyl S-ethylcarbamoylmethyl phosphorodithioate) per 100 gal. gave complete control of the aphid. Diazinon, used at 1 lb. 25 per cent. wettable powder per 100 U.S. gal., was the only effective non-systemic material, giving about 99 per cent. control.

Aphis pomi did not become a problem until June in either year, and repeated reinfestation made control difficult. Non-systemic compounds, although reducing the population, did not prevent reinfestation and a rapid increase in population, but some systemic treatments gave very good control. The most effective were 1 quart 48 per cent. phorate per 100 gal., applied on 11th July 1957, and 1 quart 25 per cent. 18706 and 1 pint 18 per cent. Di-Syston or 50 per cent. dimethoate per 100 gal., applied in emulsion sprays on 2nd June and 1st July 1958. *P. ulmi*, which was present in all plots, was controlled by Di-Syston and dimethoate.

Crowell (H. H.). **Biology and economic status of** *Hylemya fugax* **(Meigen) in Oregon.**—*J. econ. Ent.* **52** no. 3 pp. 503–506, 1 fig., 9 refs. Menasha, Wis., 1959.

Records of *Hylemyia fugax* (Mg.) in various countries, usually in association with crucifers, are reviewed, and characters by which the egg, larva and adults can be recognised in the field are described. Adults have been collected in all months from March to November throughout the Willamette Valley of Oregon, and they comprised 67 per cent. of the Anthomyiids collected from wild mustard (*Brassica campestris*) between 13th April and 5th May 1952 and 87 per cent. of those emerging from hibernation in an old planting of broccoli in the spring of 1949 at Corvallis. *H. fugax* overwinters in the pupal stage in the soil or among plant débris and emerges about 1–2 weeks earlier than *H. brassicae* (Bch.). There are probably several generations a year. Cauliflower is one of the crops infested, and eggs and larvae were found in cauliflower heads on 20th November and larvae on 17th December, indicating that they are probably active until the onset of freezing weather. There were no signs of feeding on the leaves or stalks, and an observed association of the insects with débris suggests that they are saprophytic in habit [*cf. R.A.E.*, A **40** 199]. The larvae discoloured the heads, apparently by scraping the epidermal tissue while feeding on decaying organic matter on the surface.

Steinhaus (E. A.). **On the improbability of** *Bacillus thuringiensis* **Berliner mutating to forms pathogenic for vertebrates.**—*J. econ. Ent.* **52** no. 3 pp. 506–508, 4 refs. Menasha, Wis., 1959.

The following is virtually the author's abstract. On the basis of theoretical considerations, as well as experimental evidence, there appears to be little reason to believe that crystalliferous *Bacillus thuringiensis* and its close varieties, as they occur in properly prepared microbial insecticides, are

likely to mutate spontaneously into forms pathogenic for vertebrates. Similarly, on the bases of our present understanding of bacterial genetics, it appears that such mutations are not very likely with most of the truly entomogenous bacteria. At least, the possibilities in this regard do not appear to be sufficient to preclude the use of adequately tested entomogenous micro-organisms for pest control purposes. Nevertheless, safeguards should be maintained to detect such events should they occur [*cf. R.A.E.*, A **47** 14].

Long (W. H.) & Lilly (J. H.). **Effects of chemical seed treatments on wireworm activities.**—*J. econ. Ent.* **52** no. 3 pp. 509–511, 6 refs. Menasha, Wis., 1959.

In further laboratory tests on the effectiveness of insecticides in protecting maize seeds against wireworms of the group of *Melanotus communis* (Gylh.) [*cf. R.A.E.*, A **47** 323], aldrin, dieldrin, endrin, heptachlor and lindane [almost pure γ BHC] were mixed with the seed at rates of 0·5, 1 or 2 oz. actual compound per bushel, in a commercial powder or in experimental formulations with Carbowax 6000 or powdered vermiculite. Factorial experiments in which five wireworms, collected from maize fields in Iowa, and five seeds were confined together in moist soil for eight days, after which the surviving wireworms were transferred to fresh soil with untreated seed as food for 13 days, showed that aldrin, followed by heptachlor, gave the best wireworm kill, γ BHC, followed by dieldrin, intermediate kill and endrin practically none; mortality increased consistently as the amount of insecticide was increased, and Carbowax was slightly less effective than the other diluents. Analysis of variance of the average numbers of dead and moribund wireworms showed that the differences were significant. Only γ BHC had exerted its full effect by the end of the exposure period. All treatments protected the seeds to a significant extent, γ BHC permitting only 4 per cent. attack, endrin 22 per cent. and the other compounds 11–13 per cent., as compared with 77 per cent. attack for no treatment.

It is concluded that, as well as causing the insects to move away from the treated seeds [*cf. loc. cit.*], γ BHC inhibits feeding more than the other compounds. Although it exerted its full effect more rapidly, aldrin and heptachlor had a greater total effect. These and dieldrin inhibited feeding to about the same degree, but the relatively greater inherent toxicity of aldrin appears to make it the best treatment. The possession of both types of repellency makes γ BHC less potentially useful than heptachlor, which is more toxic than dieldrin and less repellent than γ BHC or aldrin. It is concluded that treatment with 2 oz. aldrin or heptachlor per bushel of seed should give more satisfactory protection than has generally been reported.

Griffiths (D. A.), Hodson (A. C.) & Christensen (C. M.). **Grain storage fungi associated with mites.**—*J. econ. Ent.* **52** no. 3 pp. 514–518, 2 figs., 6 refs. Menasha, Wis., 1959.

The following is substantially the authors' abstract. *Tyroglyphus farinae* (Deg.) (*Acarus siro*, auct.) and *Tyrophagus castellanii* (Hirst) were found in fair abundance in Minnesota in samples of commercially stored wheat of 13·5–15 per cent. moisture content, the range of moisture within which injurious fungi of the group of *Aspergillus glaucus* are known to thrive. In tests in mouldy grain, the developing mites picked up spores of the fungi

and carried them on the outside of the body or in the digestive tract. As they entered clean grain, they inoculated it heavily with the spores, and they later fed to a considerable extent on the fungi that developed. They preferred fungi of the group of *A. glaucus* to species of *Aspergillus* that require more moisture, and they not only sought out the preferred fungi, when given a free choice, but also digested a considerably greater proportion of spores of the preferred than of the non-preferred species. It is concluded that heavy infestations of these mites in grain result in damage not only from their feeding on the embryos of the kernels, but also from the storage fungi that accompany them.

Kerr (T. W.) & Olney (C. E.). **Laboratory studies of the seasonal tolerance of the potato flea beetle to DDT.**—*J. econ. Ent.* **52** no. 3 pp. 519–521, 2 refs. Menasha, Wis., 1959.

DDT has given erratic control of *Epitrix cucumeris* (Harris) on potato in Rhode Island, and the causes were investigated in the laboratory in 1957–58. The flea-beetle has only one generation a year, and overwintered adults are present in potato fields from early May to early July and those of the new generation from mid-July to early September. Adults collected at intervals from one field in an area of intensive potato production, which had received 7–9 lb. DDT per acre each year from 1946 to 1955, and from another, about a mile from the nearest potato field, which had received 3–4 lb. DDT per acre in six of these years, were exposed to various deposits of DDT in jars for 24 or sometimes for 48 hours. The LD50's in 24 hours, determined from the dosage-mortality curves, varied from 0·1 to 3·4 μg. per sq. in. in June and early July, but from 13·5 μg. in late July to 590–1075 in late August or early September.

In a field test, treatment with 2 lb. 50 per cent. wettable DDT per 100 U.S. gal., applied at 175 U.S. gal. per acre on 11th July, caused 82 per cent. reduction in population after two days. The results given by field spraying from 1946 onwards showed that this rate of DDT gave more than 90 per cent. reduction of overwintered adults but only 38–88 per cent. reduction of the new generation, with the lower values more frequent late in the season, and it appears that DDT gives good control of overwintered adults, but that those of the new generation are more tolerant and become increasingly so as the season progresses.

Similar results were obtained in less extensive investigations with dieldrin, which was effective at much lower rates, the LD50's being below 0·09 μg. per sq. in. for the overwintered adults and rising to 38·5 in late August.

Laudani (H.), Bry (R. E.) & McDonald (L. L.). **A new method of using lindane crystals for protecting boxed woolens against fabric-insect damage.**—*J. econ. Ent.* **52** no. 3 pp. 525–527, 1 ref. Menasha, Wis., 1959.

The following is based on the authors' abstract. Long-term storage tests have shown that crystals of lindane [almost pure γ BHC] used at 5 g. per cu. ft. protected boxed woollen garments against insect damage for three years or longer, whereas naphthalene crystals at 46 g. per cu. ft. gave protection for only one year. To overcome the objection of having loose γ BHC crystals among the clothing when it was unpacked, a method was developed whereby they were fixed to sheets of paper or fibreboard with a fast-drying adhesive and introduced into the containers in this form.

Laboratory tests with 10 g. γ BHC per cu. ft. showed that the compound was as toxic to larvae of *Attagenus megatoma* (F.) (*piceus* (Ol.)) and *Anthrenus flavipes* Lec. in this form as in loose crystals after exposure for 14–21 days, but that the loose crystals were the more toxic in shorter exposures.

Harries (F. H.) & Burts (E.). **Laboratory studies of pear psyllas resistant to dieldrin and some related compounds.**—*J. econ. Ent.* **52** no. 3 p. 530. Menasha, Wis., 1959.

In the tests described, twigs infested by *Psylla pyricola* Först. were collected in September from pear trees in three orchards near Yakima, Washington, in which dieldrin had failed to control the Psyllid, and from one near East Wenatchee, where dieldrin had been effective, sprayed with five concentrations of insecticide and examined 48 hours later. Dieldrin, endrin and toxaphene caused averages of 3·3, 15·3 and 17·3 per cent. mortality of nymphs from Yakima and 62, 100 and 34 per cent. of those from Wenatchee, respectively, whereas Sevin gave higher kills of the Yakima than of the Wenatchee strain. Later in the month, dieldrin, endrin and toxaphene killed 38, 36 and 54 per cent. of the Yakima strain and 70, 82 and 68 per cent. of the Wenatchee strain.

In late September, it was reported that the Psyllid was difficult to control near Malaga, a few miles south of Wenatchee, and laboratory tests showed average mortalities of 19, 39, 52 and 92 per cent. from dieldrin, endrin, toxaphene and Sevin, as compared with 76, 87, 79 and 73 per cent. for the Wenatchee strain. The LD50's for dieldrin, endrin and toxaphene were about 10, 15 and 3 times as great for the Malaga as for the Wenatchee strain.

Struble (G. R.) & Martignoni (M. E.). **Role of parasites and disease in controlling** *Recurvaria milleri* **Busck.**—*J. econ. Ent.* **52** no. 3 pp. 531–532, 7 refs. Menasha, Wis., 1959.

Several attempts have been made to control *Recurvaria milleri* Busck on lodgepole pine [*Pinus contorta*] at high altitudes in the Yosemite National Park, California, by means of insecticides [*cf. R.A.E.*, A **30** 522], but such treatments give only temporary reductions, and permanent control by natural enemies is required. The species is attacked by numerous insects [*cf.* **48** 257], and a list is given of 12 species of Hymenopterous parasites that have been reared from the larvae and pupae. A granulosis virus was isolated from larvae collected in 1951, and about 30 per cent. of the larvae were found to be infected with it in 1952. In June 1953, there was about 30–50 per cent. mortality due to granulosis in two areas with populations of 20–45 larvae per five-inch twig, but adult emergence was nevertheless heavy; numerous eggs were laid, large numbers of larvae became established, and increasingly greater numbers of moths emerged at the maturity of this and the next generation in 1955 and 1957, respectively. Parasitism by insects apparently caused 6–10 per cent. mortality of the older larvae and nearly 40 per cent. mortality of pupae. The virus disease occurred in only one locality in the 1955–57 generation and caused only 2·9 per cent. mortality. No mortality due to the virus was found by sampling in June–July 1957, but histological preparations of larvae originally considered healthy revealed polyembryonic parasitism, presumably by *Copidosoma* sp., in 24·9 per cent. of the specimens examined. It is concluded that insect parasites are the most important natural enemies of *R. milleri* and merit further study.

Milne (A.). **Weather, enemies and natural control of insect populations.**—*J. econ. Ent.* **52** no. 3 pp. 532–533, 6 refs. Menasha, Wis., 1959.

The author replies to criticisms by P. DeBach in a paper already noticed [*R.A.E.*, A **47** 425] of the views that he expressed as to the importance of natural enemies in the control of insect populations [*cf.* **46** 392]. He concludes that the field work reported by DeBach does not prove that either enemies or weather effects can control population by themselves, but merely that each can occasionally be mainly, though never wholly, responsible for control.

Lund (H. O.). **Tests of the ability of *Reticulitermes flavipes* (Kollar) to build tubes over pine wood chemically treated for rot control.**—*J. econ. Ent.* **52** no. 3 pp. 533–534, 1 fig. Menasha, Wis., 1959.

The tests described were carried out because the ability of *Reticulitermes flavipes* (Koll.) to build tubes over timbers treated with certain fungicidal wood preservatives in the south-eastern United States is seldom mentioned in the literature. A block of wood, partly eaten by termites, was tacked on the top of a pedestal of treated wood; this was placed on end in a 2-in. layer of damp soil, in a jar from which light was excluded, and 300–500 termites were released on the block, allowed to drop to the soil, and left at room temperature. Complete tubes had been constructed over pedestals treated with Osmose and Wolman salts in 9 and 28 days, respectively, over one cut from an old creosote-treated pole and one freshly creosoted under pressure in 12 and 19 days and over one soaked for a week in a 2 per cent. solution of copper naphthenate in fuel oil in 27 days, whereas a pedestal soaked in a 2 per cent. solution of pentachlorophenol in fuel oil for several days and then dried for three days had not been built over after eight weeks.

Shorey (H. H.) & Gyrisco (G. G.). **The logarithmic sprayer for field-screening insecticides for meadow spittlebug nymph control.**—*J. econ. Ent.* **52** no. 3 pp. 534–535. Menasha, Wis., 1959.

In view of the difficulty of determining the minimum effective concentrations of insecticides in comparative tests against *Philaenus leucophthalmus* (L.) on forage crops in New York, a sprayer designed to deliver a logarithmically decreasing concentration of chemical as it moves along an experimental plot was tested in the spring of 1958. The insecticide is continuously diluted with additional water in the tank while the machine is in operation, and calibration enables the concentration delivered at any point to be calculated from the initial concentration. Plots of birdsfoot trefoil [*Lotus corniculatus*] were treated with emulsion sprays of lindane [almost pure γ BHC], Thiodan or Guthion on 15th May at rates that varied from 0·43 lb. actual compound per acre 30 ft. from the beginning of the plot to 0·03 lb. 105–110 ft. along it, and counts of nymphs, made at 10-ft. intervals between these points on 5th June, showed that Guthion gave a high degree of control at 0·23 lb. and γ BHC and Thiodan at 0·04 lb. per acre. The logarithmic sprayer is believed to have given more precise limits of effective concentration than could be obtained from a conventional spray machine delivering a single concentration to each plot. More precise comparisons can be made by narrowing the distance between sampling intervals, extending the length of the plot and increasing the number of replications. The use of this apparatus appears to be limited to insects

that have little mobility, since movement during the test period would falsify the results.

Thompson (E. G.) & Henderson (C. F.). **Effect of seed treatment with insecticides on rate of seeding wheat.**—*J. econ. Ent.* **52** no. 3 p. 535, 1 ref. Menasha, Wis., 1959.

Seed-treatment of wheat against *Petrobia latens* (Müller) and *Elcodes* sp. in Oklahoma caused a reduction in plant stand, and the cause was investigated in laboratory tests. When untreated seeds and seeds treated with 18·2 or 27·3 oz. 44 per cent. phorate (Thimet) on activated carbon per 100 lb. against *Petrobia* or with 4 oz. 50 per cent. wettable dieldrin or 7 oz. 40 per cent. wettable aldrin per 100 lb. against *Elcodes* were germinated on damp blotting paper, the treated seeds showed no significant reduction in germination. However, the four treatments reduced the weight per bushel of seed by 4, 5·3, 2·9 and 4·1 per cent., respectively, so reducing the ability of the seed to flow, and tests with a seed drill showed that the rates of sowing were reduced by 15·2, 21, 9·3 and 13·1 per cent.

Batth (S. S.) & Davidson (R. H.). **Tedion induced sterility of *Tetranychus telarius* (L.).**—*J. econ. Ent.* **52** no. 3 pp. 535–536, 2 refs. Menasha, Wis., 1959.

In view of reports that Tedion affected the developing eggs in the ovaries of *Tetranychus telarius* (L.) (*urticae* Koch) and *Panonychus ulmi* (Koch) for five days after the females had taken it up orally or by contact [*R.A.E.*, A **48** 274], tests were made in which females of *T. telarius* were sprayed with different concentrations of wettable Tedion and transferred after 24 hours to untreated leaves, on which they fed and oviposited. After a further 24 hours, all mobile stages were removed, and daily counts of the numbers of eggs that hatched showed that treatment with 0·5, 1, 2 and 4 g. actual compound per 1,000 ml. water reduced the average percentage hatch from 96·3 for no treatment to 54, 16·4, 12 and 3, respectively; all hatching occurred within five days.

Flanders (S. E.) & Fisher (T. W.). **The economic effect of aphidophagous insects on *Citrus* in South China.**—*J. econ. Ent.* **52** no. 3 pp. 536–537, 4 refs. Menasha, Wis., 1959.

A nine-month survey in 1953–54 of insects attacking *Citrus* in the New Territories of Hong Kong revealed the presence of very few aphids and no injury due to them, although tree condition, temperature and humidity appeared favourable for their reproduction and increase. Black and green species were found, but are not named. In tests on the cause of the scarcity, aphid colonies were allowed to develop on branches caged in muslin sleeves and then exposed to attack by natural enemies. Syrphids, a Braconid, probably of the genus *Trioxys*, and a species of *Aphelinus* oviposited in the colonies within a few hours and destroyed them in a few days. As the season advanced and temperature and humidity rose, attendance by ants increased, and the proportion of primary parasites to hyperparasites and predators, which are less disturbed by the ants, decreased.

Parasitised aphids from *Citrus* were sent to California in 1954–55, and *Aphelinus chaonia* Wlk., *Aphelinus* sp. near *toxopteraphidis* Kurd., *Trioxys*

sp. and *Diaeretus* (*Lipolexis*) sp. were reared from them. *Diaeretus* reproduced for one generation on nearly mature individuals of *Aphis gossypii* Glov. on squash, with a life-cycle of 14 days at temperatures of 78–80°F. *Aphelinus chaonia*, a biparental species that readily oviposited in immature black aphids in Hong Kong and also fed on the body fluids, was propagated on *Aphis spiraecola* Patch, an important pest of *Citrus*, and the other species of *Aphelinus*, which has similar habits, on *Myzus persicae* (Sulz.) on potato shoots. In 1954–57, the former was released against *Aphis spiraecola* on *Citrus* in Orange County and the latter against *M. persicae*, *A. spiraecola* and *Toxoptera aurantii* (Boy.) in Monterey and Ventura Counties. A species of *Aphidencyrtus* included in the shipments proved to be hyperparasitic, attacking *Aphelinus* sp. It oviposited in the living aphid and had a minimum life-cycle of less than 18 days at 80°F., whereas that of its host was 15 days.

Simpson (R. G.), Burkhardt (C. C.), Maxwell (F. G.) & Ortman (E. E.). **A Chalcid parasitizing spotted alfalfa aphids and greenbugs in Kansas.**—*J. econ. Ent.* **52** no. 3 pp. 537–538, 2 refs. Menasha, Wis., 1959.

Large numbers of *Aphelinus semiflavus* How., introduced into the United States from Israel and France for the control of *Therioaphis maculata* (Buckt.) [*cf. R.A.E.*, A **46** 231], were reared in New Jersey and liberated in east-central and north-central Kansas in May–June 1956, and a few were recovered from the release sites in the autumn. The insect had previously been collected in Kansas as a native parasite of other aphids. In July–August 1958, it attacked greenhouse cultures of *T. maculata*, and it could not be determined whether the native or the introduced strain was responsible; the collection contained both macropterous and brachypterous forms. *A. semiflavus* and *Aphidencyrtus aphidivorus* (Mayr), which was possibly a secondary parasite, were collected from another greenhouse culture of *Therioaphis* in September, and cultures of *Toxoptera graminum* (Rond.) in an insectary became heavily parasitised by *Aphelinus*, presumably introduced with parasitised *Therioaphis* on lucerne cuttings, in September and October. All the parasite outbreaks gradually increased and threatened to destroy the cultures.

Sternburg (J.) & Corrigan (J.). **Rapid collection of insect blood.**—*J. econ. Ent.* **52** no. 3 pp. 538–539, 1 ref. Menasha, Wis., 1959.

A method was developed during an investigation of biochemical changes in the haemolymph of insects poisoned with DDT, by which comparatively large quantities of the haemolymph of *Periplaneta americana* (L.) were collected by centrifuging. After the body openings had been sealed and the legs and antennae severed, 8–10 cockroaches were put head-downwards on a perforated disk fixed about 40 mm. below the top of each centrifuge tube, the tubes were spun for 5–10 minutes, during which the haemolymph was thrown down through the disk as a clear serum with the cells massed in a layer on the bottom of the tube, and the serum was then decanted or remixed with the cells by gentle swirling.

Harding (J. A.). **Tests comparing insecticides for the control of thrips on spinach.**—*J. econ. Ent.* **52** no. 3 pp. 540–541, 3 refs. Menasha, Wis., 1959. **Erratum.**—*T. c.* no. 4 p. 754.

Thrips increased on spinach grown for canning in the Winter Garden area of Texas in early December 1958 and reached a population of 4–10 per

mature plant by mid-January 1959. The principal species was *Frankliniella occidentalis* (Perg.), and though infestations of 20–26 per plant caused no obvious damage, their presence on the harvested plants is undesirable, and insecticides were tested for their control in sprays applied at 5 U.S. gal. per acre on 13th–14th January. Counts made 1–10 days after treatment showed that 1 lb. malathion, dicapthon or ethyl-DDD (Perthane) and 0·5 lb. parathion, Guthion or Phosdrin per acre gave the best results and were more persistent than 0·5 lb. diazinon, trichlorphon (Dylox), ethion or Dibrom (dimethyl 1,2-dibromo-2,2-dichloroethyl phosphate), 0·75 lb. Thiodan, Trithion or Dow ET-57 (O,O-dimethyl O-2,4,5-trichlorophenyl phosphorothioate) or pyrethrum mixtures, though all gave fair control. Dicapthon caused severe damage to the foliage in the formulation used.

Young (J. R.) & Ditman (L. P.). **Effectiveness of some newer insecticides for control of** *Macrosiphum pisi* **(Harris) and** *Epilachna varivestis* **Muls.** —*J. econ. Ent.* **52** no. 3 pp. 541–542, 2 refs. Menasha, Wis., 1959.

In small-plot experiments in Maryland in 1958, applications of 0·5 lb. dimethoate, Am.Cyanamid 18706 (O,O-dimethyl S-ethylcarbamoylmethyl phosphorodithioate), Thiodan or diazinon, 1·25 lb. malathion or 1 lb. phosphamidon, dicapthon or Dibrom (dimethyl 1,2-dibromo-2,2-dichloroethyl phosphate) in 25 U.S. gal. emulsion spray per acre to peas on 27th May reduced the numbers of *Macrosiphum pisum* (Harris) caught 48 hours later to 0–1 per sweep of an insect net; only 9 per sweep were caught on untreated plots, probably owing to spray drift, and there were no effects on yield. On more widely spaced plots, applications of 1 lb. Trithion, dimethoate or phosphamidon, 0·5 lb. 18706 or 1·25 lb. malathion in 25 U.S. gal. spray on 24th June reduced the numbers from an average of 129 before treatment to 0–0·5, as compared with 105 per sweep in untreated plots.

Similar applications of malathion, dimethoate, 18706 and phosphamidon on 24th June and 7th July to snap beans infested with *Epilachna varivestis* Muls. reduced the percentages of pods showing feeding injury from 37·5 to zero, reduced scarring of unknown origin, increased the yield, though not significantly, and did not affect flavour.

Harvey (G. T.). **A relationship between photoperiod and cold-storage treatment in the spruce budworm.**—*Science* **128** no. 3333 pp. 1205–1206, 1 graph, 3 refs. Lancaster, Pa., 1958.

The following is virtually the author's abstract of this account of observations in Canada. Exposure of diapausing second-instar larvae of *Choristoneura fumiferana* (Clem.) to continuous light at 21°C. [69·8°F.], after only six weeks' storage at 0°C. [32°F.], induces emergence of larvae that will not emerge at photoperiods of 15 or 18 hours. Following the normal storage period (20 weeks), there is no such effect. Complete darkness or 12-hour photoperiods inhibit emergence after storage periods of all lengths.

Bondarenko (N. V.). **Characteristics of the diapause in** *Tetranychus urticae* **Koch.** [*In Russian.*]—*Zool. Zh.* **37** pt. 7 pp. 1012–1023, 23 refs. Moscow, 1958. (With a summary in English.)

Investigations were begun in Leningrad in 1947 on the diapause in females of *Tetranychus telarius* (L.) (*urticae* Koch) in northern regions [*cf. R.A.E.*,

A **47** 230, etc.]. In experiments on the control of the mite on cucumber in greenhouses, reported in 1952, the daylight period was shortened to 13 hours over a period of 30 days, and feeding and reproduction by summer females ceased almost completely. There were no harmful effects on the plants, and the yield was over 20 per cent. higher than in plants exposed to normal daylight.

As complete darkness is difficult to attain under daylight conditions, tests were carried out to ascertain the maximum light intensity that would not upset this reaction. Mites in the first nymphal instar were used. The daylight period was reduced to 12 hours and, during the periods of nominal darkness, the plants were covered with layers of muslin of varying thicknesses or placed at varying distances from a 25-watt electric bulb. It was found that the proportion of diapause females produced increased as the number of layers of muslin increased or as the light decreased in intensity, the threshold of light intensity for the production of 100 per cent. diapause females being below 3·5 lux. At high temperatures (24–26°C. [75·2–78·8°F.]), a shortened daylight period did not always produce 100 per cent. diapause females and none at all occurred at 34°C. [93·2°F.]. At 15°C. [59°F.], 98·5 per cent. diapause females were produced, and when the temperature was 34°C. during the day and 18–20°C. [64·4–68°F.] at night, the percentage was 31·1. It was concluded that high temperatures may counteract a shortened daylight period, and this is supported by the fact that the mites increase in numbers in early spring in spite of short photoperiods. Furthermore, diapause females appeared more rapidly on severely injured leaves than on those only lightly attacked, so that the quality of the food also has an effect. Where there is a particularly heavy infestation and not enough food to support the mite population, an unusually large number of diapause females may be produced.

Increasing the osmotic pressure in a plant by adding nutrients to the soil has been used successfully to control other pests, and this method was tested against *T. telarius*. Six pots, each containing three cucumber plants, were used, and a complete (NPK) fertiliser was added in water to four of them at the usual rate 1, 3, 6 or 9 times as the plants grew; the fifth received one application of the fertiliser with common salt (sodium chloride), and the sixth no added nutrients. The moisture of the soil was kept constant. On 2nd–3rd July, the plants were each infested with mites, including adults of both sexes and nymphs, at the rate of 300 per pot. Analyses of the foliage, made between 11th July and 11th August, showed that the osmotic pressure in the leaves of the treated plants was 2–3 times as great as in those of the untreated ones. Plants receiving nine applications of fertiliser, or one with salt, were injured, and further doses killed them. Counts on 12th–17th August showed that the numbers of *T. telarius* were, in each case, about double those on the control plants, but the mites showed no tendency to migrate and no differences in the numbers of diapause females produced. It is concluded that the general condition of the plant rather than the osmotic pressure determines the numbers of *T. telarius* and that the addition of minerals superfluous for normal plant growth increases them [*cf.* **47** 330].

In experiments on termination of the diapause, batches of diapause females on cucumber leaves were placed in glass jars and kept in a refrigerator at 3–6°C. [37·4–42·8°F.], control batches being kept in the dark at 17–22°C. [62·6–71·6°F.] for 55 days. All were subsequently transferred to healthy plants in pots. When two batches of 100 individuals were refrigerated for 45 and 55 days, 12 and 14 mites, respectively, survived, and one of the first lot and 12 of the second fed and oviposited on the plants. Of two further batches of 50, refrigerated for 62 and 75 days, five remained alive in each case and four of the first and all the second lot oviposited.

None of the mites kept without refrigeration oviposited. The high mortality in the experiment is attributed partly to low relative humidity in the refrigator. In similar work in England [*cf.* **42** 317], at least 75–100 days of refrigeration was needed to induce oviposition.

Basurmanova (O. K.). **Biological forms of the Buprestid, *Agrilus viridis* L.** [*In Russian.*]—*Zool. Zh.* **37** pt. 7 pp. 1039–1044, 6 figs., 16 refs. Moscow, 1958. (With a summary in English.)

Observations on *Agrilus viridis* (L.), which attacks plantations of maples (*Acer*) in the steppe regions of the Soviet Union, causing losses of up to 78·7 per cent., showed that two biological forms of this Buprestid occur, one on *A. platanoides* and *A. campestre* and the other on *A. tataricum* and *A. ginnala*. There are differences in their bionomics and in the morphology of the adults and larvae, which are described. Although similar in outward appearance, egg-batches laid on *A. platanoides* contain 3–10 eggs, and those on *A. tataricum* 1–13, the eggs on *A. tataricum* being somewhat smaller in size. The larvae tunnel beneath the bark, forming long, straight galleries that follow the direction of the trunk on *A. tataricum* and shorter, more twisted ones on *A. platanoides*. Emergence of adults from *A. platanoides* occurs in mid-June, and is completed in a few days, whereas emergence from *A. tataricum* continues throughout the summer, as the result of a diapause of the larvae that is a normal part of their development in this tree, but occurs only under unfavourable conditions in *A. platanoides*.

Hussey (N. W.) & Gurney (B.). **Greenhouse white fly (*Trialeurodes vaporariorum* Westwood).**—*Rep. Glasshouse Crops Res. Inst. 1957* pp. 134–137, 1 graph, 6 refs. Littlehampton [1958].

Investigations on *Trialeurodes vaporariorum* (Westw.) on tomato under various environmental conditions in greenhouses in southern England showed that the larval and pupal stages averaged 9·3 and 6 days at 70°F., 7·8 and 6 days at 75°F. and 7·7 and 5·5 days at 80°F. The females lived for about 12–51, 15–57 and 12–33 days at 60, 75 and 80°F., respectively, and the numbers of eggs per female per day were about 3–5, 2–9 and 7–14, respectively. Estimates of the total numbers of eggs per plant on three tomato varieties did not suggest differences in suitability for oviposition. Methods of sampling populations of the Aleyrodid are discussed.

Some adults in cultures were attacked by *Cephalosporium aphidicola*. Tests with suspensions of spores of this fungus used as sprays showed that only the eggs and active first-instar larvae were immune to hyphal penetration, but as about 24 hours in a saturated atmosphere were needed for a high percentage germination, and as tomato foliage cannot be subjected to this without cultural or phytopathological difficulties, the tests were abandoned.

Many larvae of *T. vaporariorum* showed more than one puncture by *Encarsia formosa* Gah., but none contained more than one parasite larva. The parasite females seemed to probe the tissues as though searching for previously laid eggs, which may indicate that they cannot detect previous parasitism by external scent. First-instar larvae, which were not normally attacked, were killed by the act of oviposition. In tubes, the parasites did not seem to search for larvae as successfully on bean leaves as on tomato.

Hussey (N. W.) & Parr (W. J.). **Red spider mite** (*Tetranychus urticae* **Koch**).—*Rep. Glasshouse Crops Res. Inst. 1957* pp. 145–147, 8 refs. Littlehampton [1958].

In further tests in Britain, made by the floating-disk technique, on the development of *Tetranychus telarius* (L.) (*urticae* Koch) [*cf. R.A.E.*, A **45** 391], comparison at temperatures of 65–85°F. showed that the fecundity of both the red and the green form [*cf.* **47** 174] was adversely affected by high relative humidity and that the green form tended to reproduce the more rapidly at any combination of temperature and humidity. In practice, these trends would be affected by differential effects of temperature on the rate of growth of the two forms and differential mortality of the develop mental stages at low saturation deficiencies. Exposing the green form alternately to very low humidity and saturation for four days resulted in 11·7, 12 and 12·8 eggs per female per day for periods of saturation of 20, 16 and 8 hours a day, respectively, as compared with 9·3 and 13·4 for mites kept throughout at saturation and at low humidity, respectively, but similar exposure of both forms from the egg stage onwards showed that long periods of saturation had little effect on the development of either, though the green one seemed slightly the more resistant to them.

When cucumber plants of many varieties were set out on 5th February in two greenhouses that had been cleaned during the winter after containing heavily infested crops, observations indicated that infestation began about 20th February and that the first generation completed its development by about 8th March. Additional plants were infested by 11th–15th March, and infestation had increased and spread enough to warrant acaricidal treatment by 25th March; only green females were found.

Read (W. H.) & Hughes (J. T.). **The determination of residues of diazinon on cucumbers.**—*Rep. Glasshouse Crops Res. Inst. 1957* pp. 150–156, 7 graphs, 3 refs. Littlehampton [1958].

As only a short interval is practicable in Britain between the application of diazinon for the control of *Tetranychus telarius* (L.) (*urticae* Koch) on cucumbers and harvest, the residues left after treatment were investigated. The usual method of determination is cumbersome, and the diazinon was therefore extracted from the treated fruits with benzene and from this with 48 per cent. hydrobromic acid. Boiling this solution converted the sulphur in the diazinon molecule to hydrogen sulphide, which was removed in a stream of nitrogen and absorbed in alkaline zinc-acetate solution; the sulphide was determined spectrophotometrically after conversion to methylene blue.

In the tests, diazinon was applied in the greenhouse in an aerosol, at the rate of 3·3 g. per 1,000 cu. ft., and cucumbers selected at random immediately before treatment and one and three days later were found to contain 0·01, 0·07–0·11 and 0·11 parts of the chemical per million, respectively. A second application was made 12 days later, and three cucumbers were found to contain 0·05, 0·04 and 0·06 p.p.m. on the next day. In a later experiment, amounts of 0·006 and 0·008 p.p.m. were found before and 0·265, 0·22 and 0·21 p.p.m. 18 hours after treatment, and tests in which diazinon was added to extracts of the peel of untreated cucumbers, in order to find the effect on diazinon estimation of substances naturally occurring in the peel, showed recoveries of 62–98 per cent. when diazinon was added at rates of 0·12–0·51 p.p.m.

It is concluded, from the extremely low residues found in all tests, that treatment with diazinon shortly before harvest would entail no risk to consumers.

Gentle (V. A.). **Experiments on the control of aphids on lettuces with fluoracetamide.**—*Rep. Glasshouse Crops Res. Inst. 1957* pp. 157–158. Littlehampton [1958]. **Red spider mite investigations.**—*T.c.* p. 158.

In tests of the fumigant effect of fluoroacetamide on aphids in the greenhouse, described in the first paper, a current of air drawn through crystals of the compound at a temperature of 63°F. and then over a population of *Macrosiphum* (*Aulacorthum*) *solani* (Kalt.) of mixed ages at the rate of 0·18 litre per hour for 13 hours caused no mortality. When a dosage of 0·05 oz. fluoroacetamide per 1,000 cu. ft. was warmed gently to vaporise it in a fumigation chamber, and lettuce plants infested with either *M. solani* or *Myzus* (*Nasonovia*) *ribis-nigri* (Mosley) were exposed to it for four hours, it gave complete kill of the aphids, with slight scorching of the leaves, in 24 hours, but the plants showed distinct scorching of the outer leaves after four days; when the plants were reinfested with the first aphid, there was complete mortality up to seven days after fumigation. Both *M. ribis-nigri* and *M.* (*Aulacorthum*) *circumflexus* (Buckt.) on lettuces were killed within three days by exposure to 0·04 oz. fluoroacetamide per 1,000 cu. ft. for two hours at 60°F., and 0·015 oz. at 63°F. gave complete kill of *M. circumflexus* on both sides of detached lettuce leaves, whereas half this concentration killed only those on the upper, exposed surface. There was 9 per cent. survival of *M. ribis-nigri* on detached leaves exposed to 0·019 oz. at 59°F., and exposure to 0·024 oz. fluoroacetamide per 1,000 cu. ft. for three hours killed *M. ribis-nigri* on the outer leaves of lettuce that had begun to heart, but did not affect the aphids in the centre, which reproduced rapidly after four days.

In tests of systemic action [*cf. R.A.E.*, A **47** 164, 218], potted lettuce plants were watered with aqueous solutions to give 28, 14 and 7 parts fluoroacetamide per million of soil, infested with *M. ribis-nigri* of mixed ages and kept at temperatures of 60–65°F. and low relative humidity. There was almost complete aphid mortality and some damage to the plants after four days, but no aphid control or plant damage resulted from these dosages at temperatures of 50–55°F. and higher relative humidity, probably because the compound was not taken up rapidly enough to give a lethal concentration in the plants.

In the second paper, the author reports that the compound did not control the red spider mite [*Tetranychus telarius* (L.)] on french beans even when applied at highly phytotoxic concentrations.

Luitjes (J.) & Minderman (G.). **De spinselbladwesp van de lariks.** [The larch sawfly.]—*Ned. Boschb. Tijdschr.* **31** no. 9 pp. 245–253, 1 map, 7 refs. Wageningen, 1959. (With a summary in English.)

The following is taken from the authors' summary. *Cephalcia alpina* (Klug) was injurious to larch in Holland, principally in the north-east of the country, in 1941–50. Observations showed that the females of this sawfly lay an average of 25 eggs each. The larvae hatch in 12–24 days, depending on temperature, and feed on the short and then on the long shoots for 3·5–5 weeks. They descend to the ground when full-fed and overwinter in the soil at depths of a little more than an inch; those that

reach the prepupal stage in September pupate in the following March–April, but the others remain in diapause over a second, third or even fourth winter. The pupal stage lasts 2·5–4 weeks. Mortality of the prepupae in the soil was high in very dry periods. Of the larvae in the soil in 1950, 17 per cent. were parasitised by *Ctenopelma luciferum* (Grav.) and 30 per cent. by *Polycinetis* (*Prosmorus*) sp.

Hurpin (B.) & Vago (C.). **Les maladies du hanneton commun** (*Melolontha melolontha* **L.**) (**Col. Scarabaeidae**).—*Entomophaga* **3** no. 4 pp.285–330, 13 figs., 3 pp. refs. Paris, 1958. (With a summary in German.)

Notes are given on diseases caused by fungi, bacteria, Protozoa and rickettsiae found in larvae of *Melolontha melolontha* (L.) in France in 1950–55. The principal fungi were *Beauveria tenella* (*densa*), *B. globulifera* (*effusa*) and *Metarrhizium anisopliae*. Bacterial diseases were also common. No viruses were found, though their existence was suspected.

European and Mediterranean Plant Protection Organisation. **Colorado beetle in Europe in 1959.** [*In English & French.*]—[3 +] 19 + xvii pp., 1 map, multigraph. Paris, 1960.

The occurrence and distribution of *Leptinotarsa decemlineata* (Say) on potato in Europe in 1959 are surveyed as for previous years [*cf. R.A.E.*, A **47** 355, etc.]. Although weather conditions were in general favourable for the beetle, so that populations were numerous and three generations were produced in some places, infestation was usually controlled satisfactorily and the only areas in which it spread were to the east and south-east, in the extreme west of the Soviet Union, in Yugoslavia, and in Rumania. The European distribution of the beetle is shown on a map, and the control measures applied in the various countries are reviewed.

Papers noticed by Title only.

Nikol'skaya (M. N.). **Hymenoptera. Vol. VII, pt. 5. Chalcidoidea fam. Chalcididae and Leucospidae.** [*In Russian.*]—*Fauna SSSR* N.S. no. 76, 10¼ × 6½ in., 221 pp., 134 figs., 3 pp. refs. Moscow, Zool. Inst. Akad. Nauk SSSR, 1960. Price 15 *rub.* 60 *kop.*

Hardy (D. E.). **Insects of Hawaii. A manual of the insects of the Hawaiian Islands, including an enumeration of the species and notes on their origin, distribution, hosts, parasites, etc. Volume 10. Diptera: Nematocera—Brachycera.**—ix [+ 1] + 368 pp., 120 figs., 15¼ pp. refs. Honolulu, Univ. Hawaii Press, 1960. Price $7.00. [*Cf. R.A.E.*, A **47** 196, etc.]

Brazzel (J. R.) & Martin (D. F.). **Pink bollworm** [*Pectinophora gossypiella* (Saund.)] **resistance in cotton.**—*J. econ. Ent.* **52** no. 3 pp. 385–390, 2 graphs, 7 refs. Menasha, Wis., 1959. [*Cf. R.A.E.*, A **46** 490.]

Bel'govskiĭ (M. L.). **Inheritance of resistance to insecticides** [largely DDT and BHC] **in insects** [a review of the literature]. [*In Russian.*] —*Zool. Zh.* **37** pt. 7 pp. 1024–1038, 56 refs. Moscow, 1958. (With a summary in English.)

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